

Gravity corrections (T54)

The INTREPID Gravity tool can apply gravity corrections and calculate gravity anomalies for land gravity data, and also marine and airborne gravity data.

In this chapter:

- [Overview of the gravity corrections tool](#)
- [Key concepts for Land Gravity Acquisition](#)
- [Data reduction and network adjustment](#)
- [Utility gravity transforms](#)
- [Terrain correction](#)
- [Gravity mode settings](#)
- [Specifying input and output files](#)
- [Process menu](#)
- [Tools menu](#)
- [Spatial query](#)
- [Settings menu](#)
- [View menu](#)
- [Help](#)
- [Using task specification files](#)
- [Gravity processing reports](#)
- [Frequently asked questions](#)

For worked examples showing the use of the Gravity tool, refer to the Cookbook [Gravity field reduction and correction \(C08\)](#)

Overview of the gravity corrections tool

Parent topic:
[Gravity corrections \(T54\)](#)

You can use the help menu to display help text on the topics shown in the menu illustration below.

The INTREPID Gravity tool has four main functions:

Data reduction and network adjustment

Import land gravity field data in either AGSO or Scintrex format, and reduce the loop data to final Observed Gravity, FreeAir and Bouguer anomalies. This is a complete bundled processing sequence which involves several stages, including gravimeter calibrations, data integrity and loop structure checks, Earth tide and gravimeter drift corrections, network adjustment and global tie-in to gravity base stations. A principal facts database is created from the reduced data.

Terrain correction

Using a Digital Elevation Model (DEM), calculate terrain corrections for either land, marine or airborne data. The terrain correction can then be used to compute the Complete Bouguer anomaly. Full tensor gravity terrain corrections are also supported.

Moving Platform Gravity and Gradiometry Support

INTREPID has support for many instruments and systems for gathering gravity or

gradiometry from a craft that is moving. This covers the older L&R sea meters, including a direct algorithmic link to the original LaCoste decorrelation of wave action accelerations from the gravity. This came via a collaboration with Herb Valiant of ZLS. Also supported is the inline & cross-line geometry matrix transforms for the Lockheed-Martin Full tensor gravity gradiometry system. The FALCON instrument is also fully supported, though some of the support is distributed through several tools, especially the gfilt FFT tool, as some of the transforms have to be done using Foyurier transforms using gridded data. The GTXX, Rio VKX and Sanders instrumental systems have also been processed using this tool.

Utility gravity transforms

Open an existing gravity dataset and perform stand-alone gravity transforms, for example, forward and reverse transformations of FreeAir and Bouguer anomalies, or convert from one gravity Datum to another gravity Datum.

Key concepts for Land Gravity Acquisition

Parent topic:
**Gravity
corrections
(T54)**

You can use the help menu to display help text on the topics shown in the menu illustration below.

Survey loop

For land gravity surveys, the basic data acquisition procedure is the loop. It is required to remove the gravimeter's drift during the data reduction process. The INTREPID Gravity tool requires that loops must start and stop on the same station, unless one is a control base station, in which case they are allowed to be different.

Survey network

A land gravity survey network is a series of interlocking closed loops of gravity observations.

Gravimeter loop set (GMLS)

The GMLS is defined as one gravimeter-operator combination. The INTREPID gravity tool allows for processing of large gravity datasets that could involve multiple gravimeters and operators over many years.

Nodes

Nodes are gravity stations where more than one reading was observed.

Global nodes

Global nodes are gravity stations common to more than one gravimeter.

Gravity base stations

These are locations where the gravity value is well defined. One or more main gravity base stations are used as a reference, or control, for local surveys. The Global Adjustment processing stage ties all the GMLS survey stations back to these base stations.

The nature of the Global adjustment depends upon the number of Control stations. Where there is a single Control station, INTREPID holds that station fixed and adjusts all other stations to it. However where there is more than one Control station, INTREPID calculates a global adjustment by averaging the changes to each Control station made as a result of the network processing. In this case no single Control station remains fixed. It is presently not possible in INTREPID to influence the relative weightings of the Control stations.

Data reduction and network adjustment

Parent topic:
**Gravity
corrections
(T54)**

You can use the help menu to display help text on the topics shown in the menu illustration below.

Field data reduction and network adjustment can only be applied to land gravity data which has the survey loop structure clearly defined. The process consists of two stages, **Data Import** and **Reduce Loop data to Final**. The intent here is to provide high redundancy through good survey loop design, with one or more base stations, master nodes for each loop, and repeat stations that may not be nodes. The design of the software also makes the distinction for each Meter/Operator pair, as the care taken by an individual with a gravity meter is also very characteristic. 3 levels of error analysis are undertaken in the following 16 steps of data reduction.

Preliminary set-up

Parent topic:
**Data reduction
and network
adjustment**

For non-Scintrex gravimeters, each meter has a table of manufacturer supplied gravimeter calibration values, also called instrument factors. These must be included in a special INTREPID configuration file. The file is (**INTREPID installation folder**)/**config/gravimeter.cfg**.

Scintrex meters use a scale factor of 1.0 as a special case, and the gravimeter configuration file is not used.

Data import formats

Parent topic:
**Data reduction
and network
adjustment**

The field data must be in one of the following three formats.

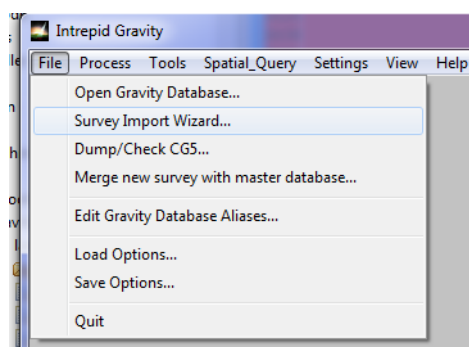
- AGSO format
- Scintrex format (CG3)
- Scintrex format (CG5)

For details of the file formats, see [Gravity import file formats \(R27\)](#).

Data import

Parent topic:
**Data reduction
and network
adjustment**

From the **File** menu, select **Survey Import Wizard**. Select the data format to import.



The **Mode** box requires you to choose appropriate settings for the gravity Datum, units, and survey environment. See [Gravity mode settings](#). The next section mostly applies to land Surface gravity acquisition, so choose **Land Surface**. The field data can also be presented in various pre-defined formats. One is the AGSO gravity field format, which is future proof, by requiring data to be in a flat ASCII file, and also requiring all the necessary data to be in just one file. Choose **AGSO Gravity Field Data**.

Process to loop data

Parent topic:
**Data reduction
and network
adjustment**

The following sequence of 8 processing steps are applied to the data:

- 1 Position Data Check
- 2 Control Data Check
- 3 Calibration Calculation
- 4 Loop Data Check
- 5 Locate Nodes (Loop Ties)
- 6 Locate Global Nodes
- 7 Repeat Nodes Check
- 8 Data Structure Integrity Check

After the import process is finished INTREPID displays a report file to the screen. We recommend you check the report carefully. In particular scroll to the bottom of the report file and ensure that all 8 processing steps were applied to completion. Bad data records, time reversals, excessive tares, duplicate loop numbers, can all cause the processing sequence to stop prematurely. If this is the case you must go back to the input data and resolve the problem before proceeding further.

After successfully completing the data import, the gravity tool creates the following point datasets:

Survey_ControlDB. .DIR

This dataset contains the Control gravity station details.

Survey_LoopDB. .DIR

This dataset contains the gravity survey data. The structure of this dataset reflects the order of the acquisition loops.

The [gravity tool](#) displays the field loop data that has just been imported.

INTREPID uses the following symbols to display the gravity dataset:

-  Gravity station (location of a gravity measurement)
-  Ties (nodes)—base station or station common to more than one loop
-  Repeated links between stations. Usually shown as white lines!

Click a station to view the data for that station. INTREPID displays the station data in a message box.

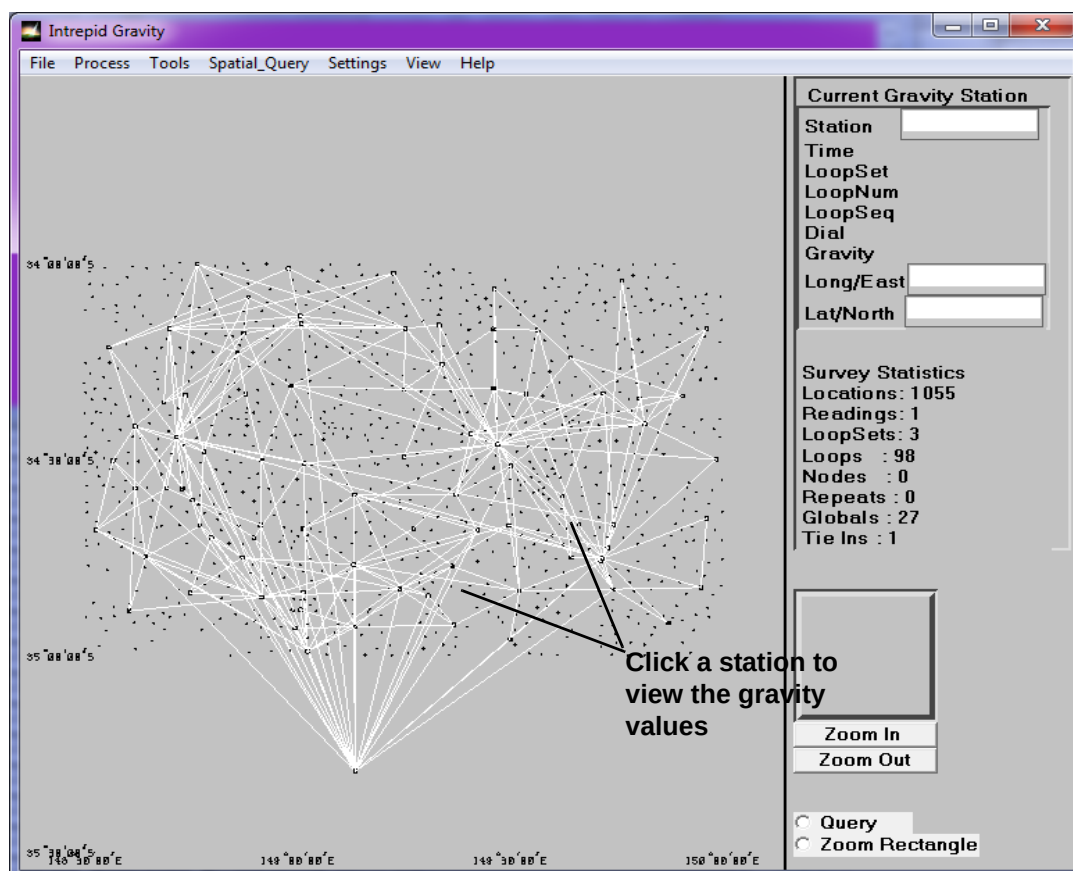


where:

Heading	Description
Station Number	Station number
Index	GMLS number Loop number Reading number within loop
Dial	Raw field gravity measurement as read from the gravimeter. The data is uncalibrated and unscaled.

Note: this numbering system begins at zero, not one! A station with an index of (0,1,2) is third station of the second loop in the first GMLS.

The data used in this manual is supplied as part of the sample_data/cookbooks/gravity_land. It comes from a Geoscience Australia gravity regional survey near Goulbourn, NSW and was acquired in 1997. So, whilst this is a reference manual, by doing an AGSO data format import of the file “AGSO_Week1&2.DAT”, you will be able to see and reproduce quite a few of the screen states described within. Of course, as this Gravity tool covers a very large set of circumstances, this guideline only applies to the land gravity acquisition and data reduction functionality.



The convention above is that a single black dot represents a gravity station with just one reading. Left mouse click a station to view the station data, including loop number, loop set and sequence number in the loop. The dial value is the actual number from the meter before calibration corrections. The white lines show nodes that have many readings connecting key stations in the loop network. This regional layout may seem foreign to some. There is a great diversity in how you design successful gravity loop surveys, with Scintrex tending to push the “grid” view more with the way the default meter wants to organise records. Temporal and spatial coherence of the gravity readings are vital, if one is to create a reduced dataset that accurately measures gravity anomalies in an area. All survey styles can be accommodated in this tool, though sometimes it does seem to be a trial, if your planning was not well documented!

INTREPID has the capacity to retrieve duplicate readings at the same station as well - the station data in a message box. (Turned off at present)

Intrepid Gravity v3.4 cut 61					
StationNumber:	97051233	Index: { 0,18,16}	Dial:	3016.367	Gravity: 979482.492
StationNumber:	97051233	Index: { 1, 2,18}	Dial:	3016.102	Gravity: 979482.411
StationNumber:	97051233	Index: { 2,20,21}	Dial:	2956.081	Gravity: 979482.801
StationNumber:	97051233	Index: { 3, 2,11}	Dial:	2955.704	Gravity: 979482.363
StationNumber:	97051233	Index: { 4,18,14}	Dial:	2999.212	Gravity: 979482.632

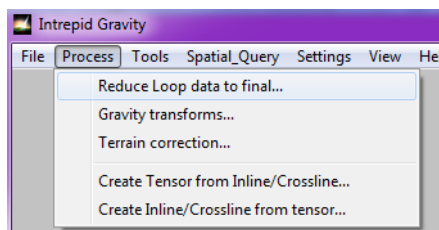
OK

Note: There is actually only one observed gravity record for each station in the reduced dataset. The observed gravity for this station is the average of the displayed values. See [INTREPID gravity point datasets \(R28\)](#) for details of the gravity point dataset.

The station data records shown are from the imported loop data, where

Heading	Description
Station Number	Station number
Index	GMLS number Loop number Reading number within loop
Dial	Raw field gravity measurement as read from the gravimeter. The data is now calibrated and scaled.
Gravity	Corrected observed gravity field. (For stations with multiple reading contains the average only.)

Stage 2 Data Reduction of Loop Data



The next step is to apply another 8 steps, including loop levelling, to produce a principal facts dataset from the field data. There is also a tie-in to one or more absolute base stations, using a least squares drift algorithm, to estimate the observed value, Free Air and a Bouguer, together with an error estimate where more than one occupation of a gravity station was undertaken. The overall accuracy of the survey is also estimated. Follow the wizard prompts. You come to the point where the initial Loop Database is requested below. Choose **Finish**..

Databases Required for Gravity Field Processing

Gravity Loop Database that has been imported previously.
Each loop must start and end with a node, unless there is just one loop

Gravity Loop Data Base
C:/Intrepid/V4.5/sample_data/cookbooks/gravity/land/des2/Survey9705_LoopDB.DIR

Control Gravity Reading Database
Node(s) that have a control or tie-in reading available

Control Gravity Observations Database:
C:/Intrepid/V4.5/sample_data/cookbooks/gravity/land/des2/Survey9705_ControlDB.DIR

Output Gravity Principal Facts Database
Loop are adjusted, drift corrected, tides & precision calc.

Output Directory name To Hold Processed Gravity databases:
C:/Intrepid/V4.5/sample_data/cookbooks/gravity/land/des2/Survey9705..DIR

Output Report File Name:
processing.rpt

Reduce loop data to final data

Parent topic:
**Data reduction
and network
adjustment**

After the **Data Import** phase, you can reduce the loop data to final data. From the **Process** menu, select **Reduce Loop data to final**. INTREPID asks you for another **Mode** review and for output dataset names. The following sequence of processing steps are then applied to the data:

- Meter Correction (uses the gravimeter calibration file)
- Earth Tide Correction
- Meter Drift Correction
- Node Levelling (network adjustment)
- Global Adjustment of Loopsets
- Apply Meter Scale Factor
- Global Adjustment (tie-in to Control)
- Report Final Values

16: Final Values

Simple Bouguer Anomaly

Terrain type: land Density: 2.670

Gravity datum: IGSN71_AGS0

Station	Latitude	Longitude	Observed	StdDev	No.	Height	Vert_Offset	Free Air	Bouguer
83910104	-35.29180	149.13793	979603.310	0.0000	44	565.000	565.00	9.7995	-53.4221
97050001	-34.98653	149.02575	979573.630	0.3017	23	613.030	613.03	20.9889	-47.6071
97053000	-34.92311	149.13862	979579.171	0.2667	7	551.991	551.99	13.0920	-48.6739
97051001	-34.91766	149.17099	979579.775		1	556.609	556.61	15.5854	-46.6973
97051002	-34.93752	149.20110	979582.801		1	559.904	559.90	17.9376	-44.7138
97051003	-34.97068	149.22058	979581.946		1	576.656	576.66	19.4305	-45.0953
97051004	-34.99010	149.26379	979584.837		1	579.199	579.20	21.4519	-43.3585
97051005	-34.99623	149.22436	979582.031		1	586.229	586.23	20.2932	-45.3038
97051006	-34.97846	149.18874	979567.771		1	638.322	638.32	23.6218	-47.8043
97051007	-34.99529	149.16110	979564.220		1	654.965	654.97	23.7743	-49.5140
97051008	-34.94436	149.15306	979572.780		1	589.025	589.02	16.3217	-49.5882
97051009	-34.88974	149.13475	979560.296		1	645.721	645.72	25.9815	-46.2725
97051010	-34.85413	149.13500	979566.550		1	604.947	604.95	22.6806	-45.0110

After the **Reduce Loop data** process is finished INTREPID displays the appended report file on the screen. Again we recommend that you check the report thoroughly.

Sections 11 and 12 contains precision statistics computed after drift, and after loop

adjustment. These provide a useful measure of how well the survey data was collected and reduced.

After successful completion of the last step, the gravity tool creates the following point dataset by default:

Survey . . DIR

This is what we refer to as the **principal facts** database. The final reduced gravity values consist of a single Observed gravity value per station. The Freeair and Bouguer anomaly values are also calculated for each data point.

Utility gravity transforms

Parent topic:
[Gravity corrections \(T54\)](#)

When field data is fully reduced using **Reduce Loop Data to Final**, quantities such as the Freeair anomaly and the Simple Bouguer anomaly are created automatically, as part of the processing sequence. However you can also calculate stand-alone gravity transforms and corrections, using an existing database of gravity data.

The examples that follow are available in the **Gravity Transforms** options, under the **Process** menu. The Gravity tool creates new fields to store these values.

In this section:

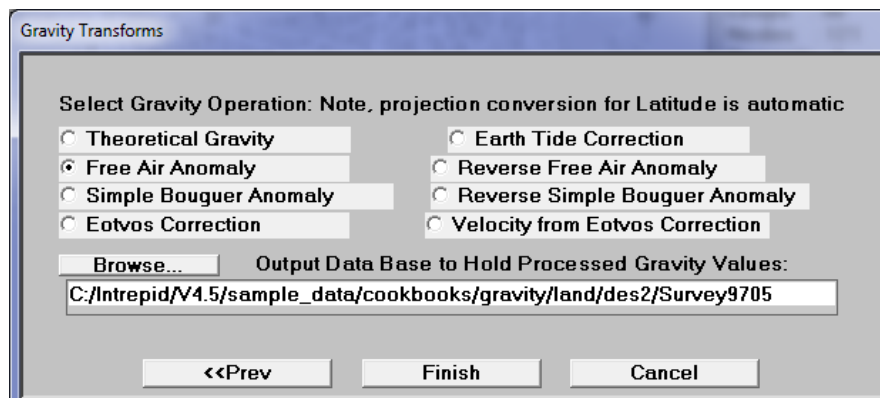
- [Instructions for gravity corrections](#)
- [Theoretical gravity](#)
- [Free air anomaly](#)
- [Reverse free air anomaly](#)
- [Simple Bouguer anomaly](#)
- [Reverse simple Bouguer anomaly](#)
- [Eötvös gravity correction](#)
- [Velocity from Eötvös gravity correction](#)

Instructions for gravity corrections

Parent topic:
[Utility gravity transforms](#)

>> *To perform gravity corrections:*

- 1 Choose **Gravity Transforms** from the **Process** menu.
- 2 In the **Mode** dialog boxes, specify the required settings (see [Gravity mode settings](#) for details).
- 3 In the **Gravity Transforms** dialog box:

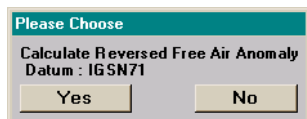


Specify the gravity dataset for correction.

Select the correction that you require.

Choose **Finish**.

- 4 INTREPID asks you for the required input and output fields (see below for details). INTREPID does not ask for a field name if there is a corresponding valid alias.
- 5 INTREPID displays the current settings (if any) to use in the calculation.



If you wish to change the settings, choose No to cancel gravity correction and then modify the gravity settings as required (see [Settings menu](#) for details).

- To continue, choose Yes.
- To cancel, choose No.

INTREPID creates the new field in the gravity dataset and appends a processing report to the current processing report file. If you have not specified a report file name during the current INTREPID session, it is named **processing.rpt** by default.

You can:

- View the processing report using a text editor.
- Use the Spreadsheet Editor to view the new data.
- Use the Visualisation tool to view the data graphically.

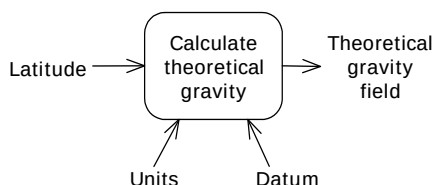
See Steps 2 and 3 of the complete Bouguer worked example in [Gravity field reduction and correction \(C08\)](#) for details.

Theoretical gravity

Parent topic:
Utility gravity transforms

The theoretical gravity (also called normal gravity) is based on a mathematical model of the earth's gravity field. It takes into account that the earth is an ellipsoid rather than a sphere, and therefore the force of gravity changes with latitude. Each ellipsoid model has a corresponding gravity datum.

INTREPID uses the latitude and datum to create a theoretical gravity field.



Input field

Latitude

Output field

Theoretical gravity (theograv)

The effect of latitude is removed by subtracting the theoretical value of gravity from the observed values. This process of subtraction is also known as a

latitude correction. INTREPID **automatically** computes and subtracts the theoretical gravity when it calculates the free air anomaly and simple Bouguer anomaly.

Sample processing report

Calculating theoretical gravity for all data base points

```
-----
Latitude field           : D:/cookbook/gravity/datasets/Survey9705/Latitude
Calculated gravity field: D:/cookbook/gravity/datasets/Survey9705/theograv
Gravity datum           : IGSN71
Gravity units           : Milligals
```

To convert data reduced to a different ellipsoid:

You may want to merge two datasets that were reduced to different ellipsoids. If the datasets do not contain an observed gravity field you can use this option to revert to observed gravity for one of the datasets. You can then reduce the observed gravity to the required ellipsoid as usual.

- 1 From the Settings menu, select the datum that was used for the original reduction. Choose Theoretical Gravity to calculate the theoretical gravity that was subtracted from the observed gravity using this ellipsoid.
- 2 Use the spreadsheet editor to reapply (add) the theoretical gravity to the corrected gravity field to recreate the observed gravity field **obsgrav**. See Step 2 of the complete Bouguer worked example in [Gravity field reduction and correction \(C08\)](#) for an example of using the Spreadsheet tool.
- 3 Select your preferred datum from the Settings menu (for example WGS84). Calculate the theoretical gravity using this preferred datum.
- 4 Use the spreadsheet editor to subtract the revised theoretical gravity from the observed gravity.

Theoretical gravity formula

Older gravity datums approximate normal gravity using truncated polynomial expansions. Recent gravity datums use Somiglianas closed form solution.

For **POTSDAM** and **IGSN71_AGSO**

$$G_n = a_1 * (1 + a_2 * \sin^2\phi + a_3 * \sin^2(2\phi))$$

For **IGSN71** and **ISOGAL80**

$$G_n = a_1 * (1 + a_2 * \sin^2\phi + a_3 * \sin^4\phi)$$

For **WGS84** and **GA07** (GRS80)

$$G_n = a_1 \frac{(1 + a_2(\sin\phi)^2)}{\sqrt{(1 + a_3(\sin\phi)^2)}}$$

Where

G_n is theoretical gravity in μms^{-2}

ϕ represents degrees of latitude

a_1, a_2, a_3 are constants listed in the table of constants. See [Gravity constants for various datums](#).

R_0 is the mean radius of the earth

Free air anomaly

Parent topic:
Utility gravity
transforms

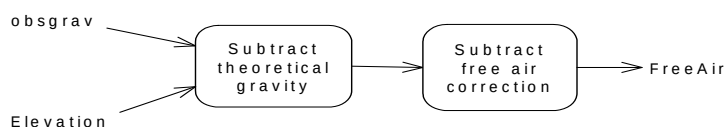
The free air correction compensates the observed gravity for the fact that it was measured at a given height above (or below) the datum.

It assumes, however, that there is nothing but air between the geoid or ellipsoid and the observation point.

INTREPID calculates the free air correction from the elevation and observed gravity fields and the terrain type.

The free air anomaly is calculated as follows:

FreeAir = **obsgrav** - theoretical gravity - free air correction



Input field	obsgrav, Latitude, Elevation
Output field	FreeAir

Free air correction formula

Here is the formula for free air correction using the full formula expressed as a vertical gradient.

For **POTSDAM** and **IGSN71_AGSO**

$$\delta g_h = -3.086 * h$$

For **IGSN71** (GRS67)

$$\delta g_h = -(3.08768 - 0.00440 \sin^2 \phi) * h + 0.000001442 * h^2$$

For **ISOGAL80**

$$\delta g_h = -3.086 * h + 7.3 * 10^{-8} * h^2$$

For **WGS84**

$$\delta g_h = -(3.083293357 + 0.004397732 * \cos^2 \phi) * h + 7.2125 * 10^{-7} * h^2$$

For **GA07** (GRS80)

$$\delta g_h = -(3.087691 - 0.004398 \sin^2 \phi) * h + 7.2125 * 10^{-7} * h^2$$

Where

δg_h is the free air correction to be subtracted, in μms^{-2} per metre

h is the height of the gravity meter above the ellipsoid

ϕ represents degrees of latitude

Correction for the mass of the atmosphere

Mass of atmosphere is not included in theoretical gravity for datums older than WGS84, thus there is no need to correct for it when calculating a free air anomaly. This correction is automatically **subtracted** from the normal gravity

For **POTSDAM**, **IGSN71_AGSO**, **IGSN71**, **ISOGAL80**

$$\delta g_{\text{atm}} = 0$$

For **WGS84**, stations above sea level:

$$\delta g_{\text{atm}} = 8.7e^{-0.116\left(\frac{h}{1000}\right)^{1.047}}$$

For **WGS84**, stations below sea level:

$$\delta g_{\text{atm}} = 8.7$$

For **GA07** (GRS80)

$$\delta g_{\text{atm}} = 8.74 - 0.000\,99 * h + 0.000\,000\,035\,6 * h^2$$

Where

δg_{atm} is the atmospheric correction in μms^{-2}

h = height above ellipsoid (not sea level) in metres

Sample processing report

Calculating Free Air Anomaly

```
-----
Observed gravity field : D:/cookbook/gravity/datasets/Survey9705/obsgrav
Latitude field         : Survey9705/Latitude
Station Elevation field : Survey9705/Elevation
Meter Elevation field  : NO METER ELEVATION DATA BEING USED
Output free air field   : D:/cookbook/gravity/datasets/Survey9705/zzzz
Gravity datum          : IGSN71
Terrain type           : land
Gravity units          : Milligals
```

Reverse free air anomaly

Parent topic:
Utility gravity
transforms

Use this correction when your data contains a free air anomaly field but no observed gravity field.

INTREPID adds the free air correction and the theoretical gravity to the free air anomaly field to recreate the observed gravity field.

obsgrav = FreeAir + free air correction + theoretical gravity

Input field	FreeAir, Latitude, Elevation,
Output field	obsgrav

Sample processing report

Reversing Free Air anomaly to observed gravity.

Free air gravity field : D:/cookbook/gravity/datasets/Survey9705/FreeAir
 Latitude field : Survey9705/Latitude
 Station Elevation field : Survey9705/Elevation
 Meter Elevation field : NO METER ELEVATION DATA BEING USED
 Output gravity field : D:/cookbook/gravity/datasets/Survey9705/obsgrav
 Gravity datum : IGSN71
 Terrain type : land
 Gravity units : Milligals

Simple Bouguer anomaly

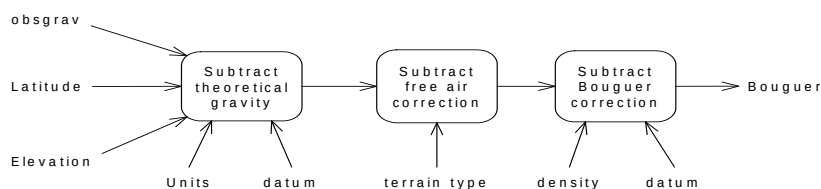
Parent topic:
Utility gravity
transforms

The simple Bouguer correction replaces the "air" in the Free Air anomaly with matter of a given density.

INTREPID uses the observed gravity field and the specified density and datum settings to calculate the simple Bouguer correction.

The simple Bouguer anomaly is calculated as follows:

Bouguer = obsgrav – theoretical gravity – free air correction – simple Bouguer correction



Input field	obsgrav, Latitude, Elevation
Output field	Bouguer

You can experiment with different density settings to create a series of simple Bouguer anomaly fields; for example **Bouguer267**, **Bouguer250**, **Bouguer200**.

Simple Bouguer correction formula (spherical cap)

For **GA07** (GRS80), the simple Bouguer correction is calculated using the following closed form equation for the gravity effect of a spherical cap of radius 166.7 km with a mean radius of 6,371.0087714 km, and height relative to the ellipsoid:

$$\text{Bouguer Correction (BC)} = 2\pi G\rho((1+\mu) * h - \lambda R)$$

Where:

π is pi

G is the gravitational constant; = $6.67428 \times 10^{-11} \text{ m}^3\text{kg}^{-1}\text{s}^{-2}$
 (Mohr and Taylor 2001)

ρ is density in tm^{-3} , typically 2.67 tm^{-3}

h is the ellipsoid height in metres of the station

R = ($R_0 + h$) the radius of the earth at the station

R_0 is the mean radius of the earth = 6,371.008 771 4 km
 (GRS 80 value from Moritz)

μ & λ are dimensionless coefficients with following definitions:

$$\mu = ((1/3) * \eta^2 - \eta)$$

where

$$\eta = h/R$$

$$\lambda = (1/3)\{(d + f\delta + \delta^2)[(f - \delta)^2 + k]^{1/2} + p + m*\ln(n/(f - \delta + [(f - \delta)^2 + k]^{1/2}))\}$$

where:

$$d = 3\cos^2\alpha - 2$$

$$f = \cos \alpha$$

$$k = \sin^2\alpha$$

$$p = -6\cos^2\alpha\sin(\alpha/2) + 4\sin^3(\alpha/2)$$

$$\delta = R_0/R$$

$$m = -3\sin^2\alpha\cos \alpha = -3kf$$

$$n = 2[\sin(\alpha/2) - \sin^2(\alpha/2)]$$

$$\alpha = S/R_0, \text{ with } S = \text{Bullard B Surface radius} = 166.735 \text{ km.}$$

Sample processing report

Calculating Simple Bouguer Anomaly

Observed gravity field : D:/gravity/import_data/Survey9533_0710/Bouguer
 Latitude field : D:/gravity/import_data/Survey9533_0710/Latitude
 Station Elevation field : D:/gravity/import_data/Survey9533_0710/Elevation
 Meter Elevation field : NO METER ELEVATION DATA BEING USED
 Bouguer anomaly field : D:/gravity/import_data/Survey9533_0710/Bouguer2
 Gravity datum : IGSN71
 Terrain type : land
 Density : 2.670
 Gravity units : Milligals

Reverse simple Bouguer anomaly

Parent topic:
Utility gravity
transforms

INTREPID calculates the observed gravity from the simple Bouguer gravity anomaly field.

obsgrav = Bouguer + simple Bouguer correction + free air correction + theoretical gravity

Input field	Bouguer, Latitude, Elevation
Output field	obsgrav

This is useful if you have data that is missing an observed gravity field and want to process it using different settings or corrections.

Sample processing report

Calculating Simple Bouguer Anomaly

Reversing Simple Bouguer anomaly to observed gravity

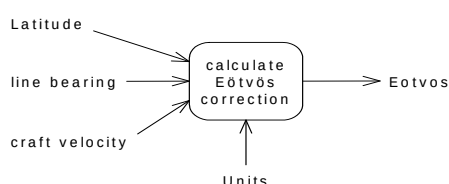
Bouguer anomaly field : D:/cookbook/gravity/datasets/Survey9705/Bouguer
 Latitude field : Survey9705/Latitude

Station Elevation field : Survey9705/Elevation
Meter Elevation field : NO METER ELEVATION DATA BEING USED
Output gravity field : D:/cookbook/gravity/datasets/Survey9705/obsgrav
Gravity datum : IGSN71
Terrain type : land
Density : 2.670
Gravity units : Milligals

Eötvös gravity correction

Parent topic:
[Utility gravity transforms](#)

The Eötvös correction is required for gravity measurements taken from a moving platform. The meter's velocity over the surface adds vectorially to the velocity due to the earth's rotation, varying the centrifugal acceleration and hence the apparent gravitational attraction. Use this correction for marine and airborne survey data before applying Latitude and FreeAir corrections.



Input field	Latitude, line bearing and craft velocity
Output field	Eotvos

WARNING: The craft velocity is in units of **knots**!

Sample processing report

Calculating Eotvos gravity for all data base points

Latitude field : D:/cookbook/gravity/datasets/Survey9705/Latitude
Line bearing field : D:/cookbook/gravity/datasets/Survey9705/bearing
Craft velocity field : D:/cookbook/gravity/datasets/Survey9705/velocity
Calculated Eotvos field: D:/cookbook/gravity/datasets/Survey9705/Eotvos
Gravity units : Milligals

Applying the correction

The Eötvös correction is positive when the craft is moving to the east (because when it moves with the earth, centrifugal acceleration is increased and the downward pull is decreased) and negative when its motion is westward.

Use the spreadsheet editor to add the Eötvös correction to your observed gravity field to create a new Eötvös corrected gravity field. See "[Complete Bouguer anomaly—worked example](#)" in [Gravity field reduction and correction \(C08\)](#) for an example of using the Spreadsheet tool.

Velocity from Eötvös gravity correction

Parent topic:
[Utility gravity transforms](#)

Given the Eötvös correction, line bearing and latitude, using this option INTREPID computes the craft velocity that was required to produce just that Eötvös effect.

Input field	Latitude, line bearing and Eötvös correction
Output field	craft velocity

WARNING:

- The Eötvös correction is in units of **milligals**.
- INTREPID computes the craft velocity in units of **knots**.

Sample processing report**Calculating velocity from Eotvos gravity for all data base points**

Latitude field : D:/cookbook/gravity/datasets/Survey9705/Latitude
 Line bearing field : D:/cookbook/gravity/datasets/Survey9705/bearing
 Calculated velocity : D:/cookbook/gravity/datasets/Survey9705/velocity
 Eotvos field : D:/cookbook/gravity/datasets/Survey9705/Eotvos
 Gravity units : Milligals

Gravity constants for various datums

Parent topic:
[Utility gravity transforms](#)

The following table shows the constants used in theoretical gravity formulas

Datum	a_1	a_2	a_3	R_0
1930 & POTSDAM & ISOGAL65 formula coefficients				
POTSDAM	9780490.0	0.0052884	-0.0000059	6371229.3154
1967 & ISOGAL84 formula coefficients				
IGSN-71_AGSO	9780318.46	0.0053024	0.0000058	6371031.5014
IGSN-71	9780318.456	0.005278895	0.000023462	6371031.5014
World Geodetic System 1972 & WGS80 formula coefficients				
ISOGAL80	9780332.7	0.005278994	0.000023461	6371008.7714
World Geodetic System 1984 & WGS84 formula coefficients				
WGS84	9780326.7714	0.00193185138639	-0.00669437999013	6371008.7714

Datum	a_1	a_2	a_3	R_0
GA07 formula coefficients				
GA07	9780326.7715	0.001931851353	-0.00669438002290	6371008.7714

Terrain correction

Parent topic:
Gravity
corrections
(T54)

The complete Bouguer anomaly reduction includes the simple Bouguer slab correction, earth curvature correction and terrain correction. The INTREPID **complete Bouguer anomaly** option calculates a terrain response for gravity data. You must provide a digital terrain model (DTM) grid which is used to calculate the terrain correction required for each gravity station. After the terrain correction has been calculated, the correction can be applied to the Bouguer anomaly using the INTREPID [spreadsheet editor](#).

Terrain correction can be calculated for either land, marine or airborne data. Full tensor gravity terrain corrections for new generation data acquisition systems are also supported. Use this option also for Falcon, then use the spreadsheet functions to re-organise the FTG tensor to create a Falcon tensor. Generally, it is best to assume a 1 g/cc density for the terrain correction phase, then use the spreadsheet editor, to scale the terrain correction with a variety of density values, to minimize the correlation of the observed gravity signal with the terrain response. This principle applies even more so for gradiometry, as from experience, 80% of the measured signal is usually due to the terrain response.

Gravity tool licensing

Parent topic:
Terrain
correction

If you are licensed for **Gravity 1**, you can calculate normal vertical gravity terrain corrections for land, airborne and marine environments.

If you are licensed for **Gravity 2**, you can calculate normal vertical and horizontal component gravity terrain corrections, as well as full tensor terrain corrections for land, airborne and marine environments.

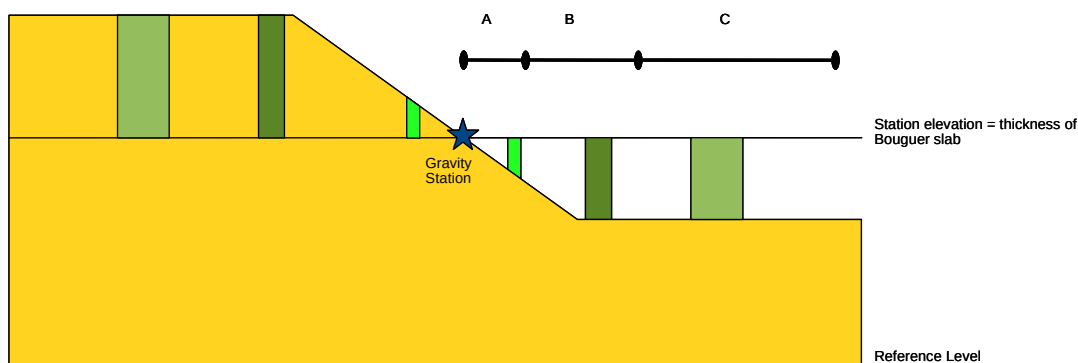
Scalar terrain corrections

Parent topic:
Terrain
correction

When simple Bouguer gravity anomalies are calculated for land gravity data, the gravity station is assumed to be located on a horizontal plane. This assumption is wrong if there is local varying topography. In this case a terrain correction must be applied to the data.

The terrain correction algorithm divides the region surrounding a gravity station into concentric rings of increasing radii. Each ring, labelled A, B and C in the figure below, is subdivided into cells. These cells are smallest in the innermost ring and increase in size with each ring (similar to the well-known Hammer method for terrain corrections).

A mean elevation is assigned to each cell and prisms are formed by projecting the cells up or down to the station elevation plane which corresponds to the top of the simple Bouguer slab. This is schematically shown in the figure below for a few prisms.



Prisms in the innermost ring (A) have a sloping top to better adapt to terrain variations within a cell. The gravity effect of prisms in outer rings (B, C) is calculated using a vertical rod approximation to speed up the computation. Each prism is assigned a standard density and the terrain correction is calculated at each station as the sum of effects due to all prisms contained within the radii. This provides maximum precision in the region nearest to the station, while allowing more efficient calculation further away.

To prevent edge effects, you should choose a DTM that is larger than your survey area. For best results, your DTM should be large enough so that for each gravity station the area used to calculate the terrain correction is completely contained within the DTM.

In areas of high relief terrain corrections can be quite high. In Australia, gravity terrain corrections can be as high as 25 mGal, and the terrain effect can extend for 50 km.

The terrain correction is added to the simple Bouguer anomaly to produce the Complete Bouguer anomaly. In the case of land gravity the terrain correction is positive everywhere. This is not necessarily true for airborne and marine terrain corrections.

Please note that INTREPID calculates the scalar terrain correction using the common convention that the vertical component of gravity is positive (the z-axis is pointing down).

A full description of the terrain correction method used in the INTREPID software can be found in the following reference: '*Application of terrain corrections in Australia*' by N. Direen, T. Luyendyk, Geoscience Australia (see [Application of terrain corrections in Australia \(C13\)](#)).

Tensor terrain corrections

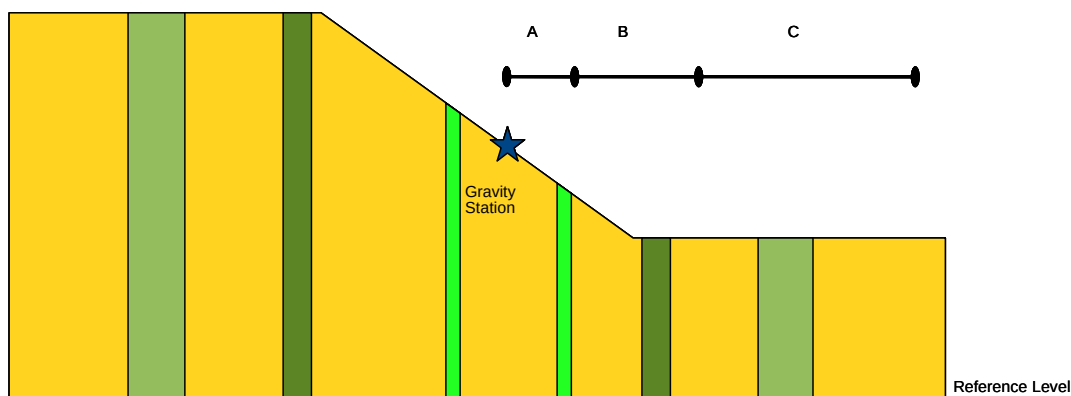
Parent topic: Terrain correction

The algorithm to calculate the terrain correction for full tensor gravity gradiometry data is essentially the same as in the scalar case. However, there is one distinct difference:

It is well known that for land-based gravity measurements the simple Bouguer correction overestimates the gravity effect of the material between the gravity station and the reference level (geoid or ellipsoid) in the presence of significant relief. The terrain correction accounts for this by calculating the effect of missing or excess mass due to variations in topography. On the other hand, the gravity effect of a infinite Bouguer slab is independent of the location and height of a gravity station on or above

the slab. The gradient tensor response of a Bouguer slab is thus identical to zero everywhere and the concept of a simple Bouguer correction is not applicable in the tensor case.

Instead, a forward model of the terrain has to be calculated to account for effects of topography on the gravity tensor. As with the scalar case, the terrain surrounding the gravity station is divided into prisms. The prisms extend from a reference level, usually the geoid or ellipsoid, to the terrain elevation (cf. the figure below). In the innermost ring sloping top prisms are used for high accuracy, whereas flat-top prisms are used in the outer rings to speed up the computation. A density is assigned to each prism and the tensor terrain correction at a gravity station is given as the sum of the gradient tensor response from all prisms inside the concentric rings.



With the evaluation of the tensor terrain correction, a forward model of the full gravity vector is also calculated. Note, that the vertical component of the gravity vector is different to the value from the scalar terrain correction. The former is the response of a complete forward model, whereas the latter accounts for the mass missing from or in excess of an infinite Bouguer slab.

Finally, the tensor terrain correction has to be subtracted from the tensor data to remove the effect of topography. This can be done using the spreadsheet editor.

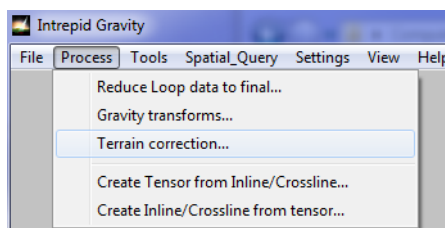
Note: The full gravity vector and the gravity gradient tensor are calculated in the ENU coordinate system, i.e. the x-axis points east, the y-axis points north and the z-axis points up.

You have to convert the tensor terrain correction first before you can subtract it from your gravity gradient tensor data if the latter is expressed in a different coordinate system such as NED (north-east-down) or END (east-north-down).

Computing a terrain correction

Parent topic:
Terrain
correction

From the Process menu, select **Terrain Correction** anomaly.



The **Mode** box requires you to choose appropriate settings for the gravity Datum, units, and survey environment. After you select the correct modes the main dialog box appears.

Parameters

Parameter	Description
Earth Curvature Correction	Converts the geometry for the correction from an infinite slab to a spherical cap with a radius of 167 km from the station. Select this option if your survey covers a wide area. This only applies to scalar terrain corrections.
Calculate Scalar Terrain correction	This is the default setting. INTREPID calculates the terrain correction for the vertical component of gravity.
Calculate Full Tensor correction	If you select this option, INTREPID calculates a full tensor terrain correction together with all components of the gravity vector. Note that the gravity gradient tensor is in the ENU system. Note that tensor terrain corrections compute a forward model of the gravity tensor based on the DTM at each observation point. This is different to scalar correction, which computes the effect of the deviation from the infinite slab or spherical cap approximation. You must be licensed for Gravity 2 to use this option.
Number of Calculation Rings	These are the rings of terrain influence surrounding the observation point. Specify a range between 1 and 5. Choosing fewer rings provides less coverage but faster processing. Choosing 5 rings gives maximum coverage and maximum accuracy but slower processing. The radius of the area processed approximately doubles for each outer ring if you use default settings. Remember that most of the terrain influence occurs in the inner rings close to the station.
Primary Cell Size	Controls the prism cell size which is used to model the terrain surface. This parameter depends on the resolution of the DTM grid. It also controls the radius of each ring (See the Advanced options below). Specify the DTM grid cell size to start with. Increasing the size increases the ring radii. The result is less accurate but it runs faster.
Density (Land)	The density in g/cm ³ assigned to prisms on land.
Density (Seawater)	The density in g/cm ³ assigned to prisms in the sea

Advanced options

Setting	Description
Terrain Bottom (RL)	Full tensor gradient terrain corrections for land/air/sea are supported. The Holstein polyhedra modelling method is used to calculate the tensor response of the terrain. The method requires a bottom RL to determine the height of the prisms.

Setting	Description
Radius (in cells) of Ring 1:5	The radius of the rings of terrain influence (in primary cell sites) can be individually modified.
Calculate scalar/tensor terrain corrections using...	The method of sloping prisms is the more accurate but slower option. Note that this only affects the prisms in the innermost ring. Outer rings always use the rod approximation pscalar cape ?? or flat top prisms (tensor case) Press the first Browse button to select your gravity dataset. Press the second Browse button to select your DTM grid. Press the third Browse button to optionally select a name for your output report file. You hve the option of writing the calculated terrain values to the report file.
Treatment of Elevation Observation Data	For ground gravity data, if the elevations calculated from the DTM differ significantly from those measured with the gravity readings, the option exists to replace all station elevations by those interpolated from the DTM grid for calculating the terrain correction. This is the default setting. Note: Do not replace observation elevation if you are processing airborne or marine data.
Include Observation Point in DTM	The elevation at each gravity station location must be estimated by interpolating from the DTM grid. You have the option of including the gravity reading elevations along with the DTM data for the interpolation process. The default setting is not to do this.
Local elevation interpolation method	The interpolation of the elevation can be done using the method of either inverse distance (default) or minimum curvature.

Press **Finish**. You are now prompted for a flag field. This can be any field in the dataset which contains valid data. If the field contains any Null values, INTREPID skips the terrain calculation for those records.

INTREPID asks you for the ground elevation field relative to the geoid. You can also specify an optional meter elevation relative to the geoid. Press **Skip** if you do not have one. You can also specify an optional gravity units field. Press **Skip** if you do not have one.

Now specify the output terrain correction field name. The default name is **compl_boug**. Choose **OK**. INTREPID starts calculating the terrain correction.

After INTREPID has computed the terrain correction, you may use the INTREPID spreadsheet editor to add it to the simple Bouguer anomaly to create the complete Bouguer anomaly.

Note however, if you are dealing with tensor data, the tensor terrain correction has to be subtracted from the full tensor data.

See "[Complete Bouguer anomaly—worked example](#)" in [Gravity field reduction and correction \(C08\)](#) for more information on the technical capabilities.

Gravity mode settings

Parent topic:
[Gravity corrections \(T54\)](#)

You can use the help menu to display help text on the topics shown in the menu illustration below.

You can change a number of INTREPID settings during a Gravity processing session.

Every time a dataset containing Gravity data is referenced, you must explicitly confirm the following essential information. This ensures that the units, geoid, ellipsoid and equations that you are expecting to use, are in fact the ones chosen. While elements of gravity data reduction appear simple, it is a known fact, that many practitioners generate anomaly numbers that are difficult to reproduce, as a simple mistake has been made in choosing the right parameters.

The 'Mode' dialog box contains the following settings:

- Please review & choose appropriate settings**
- Gravity Datum Type**
 - ☐ POTSDAM
 - ☒ IGSN71
 - ☐ IGSN71_AGSO
 - ☐ ISOGAL80
 - ☐ WGS84
 - ☐ GA07
- Output gravity units**
 - ☐ milliGals
 - ☒ um/s^2
 - ☐ microGals
- Gravity Acquisition Environment**
 - ☒ Land
 - ☐ Marine
 - ☐ Airborne
 - ☐ Lake
 - ☐ Ice
- Buttons:** Next>>, Cancel

The 'Mode' dialog box contains the following settings:

- Select Type of data to import:**
- ☒ AGSO Gravity Field Data
- ☐ SCINTREX CG3 Gravity Field Data
- ☐ SCINTREX CG5 Gravity Field Data
- ☐ Allow Close Repeats at same station
- Buttons:** Next>>, Cancel

The 'Mode' dialog box contains the following settings:

- Select detailed acquisition environment**
- ☒ Land surface
- ☐ Land subsurface
- Buttons:** Next>>, Cancel

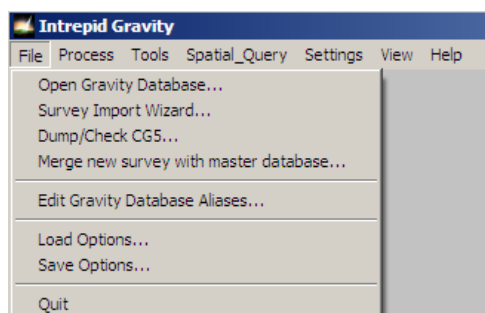
Settings and formats

Setting or format	Description
AGSO format	You are prompted for data file names, output report file name, and output database names.
Scintrex formats	You are prompted for data file names, output report file name, and output database names.
Survey Number	Used to extract just that survey number from the data file.
Survey Suffix	Only relevant for the formal AGSO import, you may ignore it
Override meter settings regarding coordinate type	Usually the values coming out of the meter are showing LatLong, though in other cases they may be a local grid, or UTM coordinates.
Gravity Datum Type	This is one of Potsdam, IGSN71, IGSN71_AGSO, IGSN71_NZ, ISO GAL80, WGS84, GA07. INTREPID uses the standard International Formulae and there are references to regional tie-ins. You can easily define new Datums as required. Please contact technical support with details of any other required tie-ins.
Output Gravity Units	INTREPID uses either mGal, μms^{-2} , or μGal . Specify the units used in the data you intend to import or process before you start the process. The default unit is mGal. One milligal (mGal) = $10 \mu\text{ms}^{-2}$
Gravity Acquisition Environment	INTREPID uses different processing parameters for land, marine and airborne gravity data. You can select Land, Marine, Airborne, Lake or Ice. The default environment is Land.

Specifying input and output files

Parent topic:
Gravity corrections (T54)

You can use the help menu to display help text on the topics shown in the menu illustration below.

Introduction to input and output files.

In each case INTREPID displays an Open or Save As dialog box. Use the directory

and file selector to locate the file you require. (See "[Specifying input and output files](#)" in [Introduction to INTREPID \(R02\)](#) for information about specifying files).

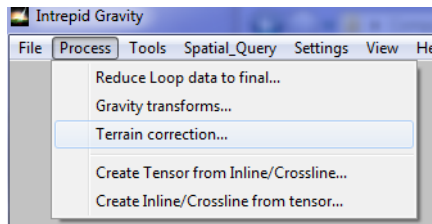
Menu options

Option	Description
Open Gravity Database	Use this to specify the gravity dataset which you wish to manipulate. You may perform utility gravity transforms and terrain corrections on an existing gravity dataset. It is also possible to open an XYZ or an existing principal facts database and make use of some of the data reduction and network adjustment tool functions. In this case only some of the processing sequence can be applied to the data. In this case you cannot then answer questions about differing precision of one reading vs another, because Gravity datum changes etc. so easily.
Survey Import Wizard	The Import Wizard is the starting point for reduction and network adjustment of field data in AGSO or Scintrex format.
Dump / Check CG5	Convert binary format CG5 data to readable ASCII. Useful for viewing the data before importing.
Merge new survey with master database	The Gravity Tool allows you to merge your current dataset with a 'master' dataset of principal facts. Fields to be merged must have the same names. Missing fields are set to Null values. This option calls a separate tool called "merge.exe" that does location and precision checks on the new data compared to the master data, and attempts to arbitrate, or make a judgement about which records are better. Exceptions are written to a log file for reprocessing/editing. Do not use this option without some planning and thought. Check the tutorial first.
Edit Gravity Database Aliases	This supports normal assigning and re-assigning of the standard INTREPID alias names.
Load Options	Select a Grdop task specification file to preload the interactive session with all the required file and parameter settings. (See Using task specification files for information about task specification files).
Save Options	Save the current Grid Operations file specifications and parameter settings as a task specification file. (See Section Using task specification files for more information).

Process menu

Parent topic:
**Gravity
corrections
(T54)**

Intro text



In this section:

- [Reduce loop data](#)
- [Gravity transforms](#)
- [Complete Bouger anomaly](#)
- [Complete Bouger anomaly advanced options](#)
- [Create tensor from inline or crossline](#)
- [Create inline or crossline from tensor](#)

Reduce loop data

Parent topic:
Process menu

Intro text

A screenshot of a dialog box titled 'Databases Required for Gravity Field Processing'. It contains four sections, each with a 'Browse...' button and a text field:

- Gravity Loop Database that has been imported previously.** Each loop must start and end with a node, unless there is just one loop. Text field: 'Gravity Loop Data Base'.
- Control Gravity Reading Database** Node(s) that have a control or tie-in reading available. Text field: 'Control Gravity Observations Database:'.
- Output Gravity Principal Facts Database** Loop are adjusted, drift corrected, tides & precision calc. Text field: 'Output Database To Hold Processed Gravity Values:'.
- Output Report File Name:** Text field: 'processing.rpt'.

At the bottom are three buttons: '<<Prev', 'Finish', and 'Cancel'.

Controls in this dialog box

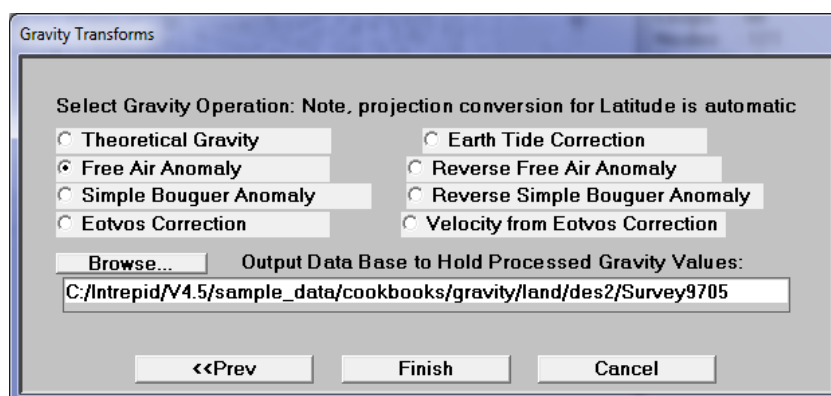
Control	Description
Gravity loop database	This is the intermediate database, with standardised fields, that capture intermediately processed field data, still in LOOP order
Control gravity observations database	Your tie-in to a national datum, or an absolute station, is kept in a much smaller, separate database. This is not strictly necessary, but your survey data cannot be interpreted or merged with other surveys, until this is done properly.
Output database	The final principal facts data reduction from your newly acquired survey, get written using standard field names, to this output gravity database.
Output report	A very comprehensive report, that pulls all your data apart, reporting on loop design, repeats, drifts, error analysis, is automatically written by the tool to this file. Please examine it carefully.

Gravity transforms

Parent topic:
[Process menu](#)

These calculator functions require supporting fields to function correctly, and you also need to know the gravity datum, if you wish for example, to reverse back to an observed gravity value from a FreeAir. Some of the prompted fields are optional extras. A **SKIP** button will present in this case.

Before a final calculation is executed, after you have been prompted for all the necessary fields to conduct your required calculation, you will get a summary pop-up describing what you are attempting to do. Please check and verify that what this reports, is what you intended to do.



Controls in this dialog box

Control	Description
Select gravity operation	Choose one of the 8 options above
Output database	Any database can be used to manage/manipulate gravity observations. The importance of these calculator functions is that data from any source and age can have reverse formulae applied, say reverse out of Potsdam, then go forward to ISOGAL. This also applies to the moving platform Eotvos correction.

Complete Bouguer anomaly

Parent topic:
[Process menu](#)

Intro text

Terrain Correction Options

Terrain correction using DTM & Hammer method
 Gravity 1 Lic. Estimates Gz
 Gravity 2 Lic. Estimates gravity tensor & Gx,Gy,Gz
 Applicable for land, airborne & marine cases
 nb Airborne tensor supports subset & interpolation

☐ Earth Curvature Correction (Infinite slab
 replaced by spherical cap of radius 166.735 km)

☒ Calculate Scalar Terrain Correction

☐ Calculate Full Tensor Correction

Airborne tensor subsample:

Number of Calculation Rings: ☐ 1 ☒ 2 ☐ 3 ☐ 4 ☐ 5

Primary Cell Size:

Density Land:

Density Marine Sediments:

Density Sea-water:

Gravity Database

Digital Terrain Model Grid

Output Report File Name:

☐ Report terrain calculations to ASCII report

Treatment of Elevation Observation Data
☐ Use elevations from Gravity Observations
☒ Re-estimate Elevation from DTM at Obs.Pt.

☐ Include Obs.Pt. in DTM

Local elevation interpolation method
☒ Inverse distance ☐ Minimum curvature

Controls in this dialog box

Control	Description
Earth curvature correction	For a scalar terrain correction, the correction at 167km and further, is the traditional Earth curvature correction.
Calculate scalar terrain correction	This is the classic case, with rods and sloping top triangle prism modelling
Calculate full tensor correction	This terrain modelling uses the Holstein facet modelling code for a FTG case.
Number of calculation rings	This comes from the Hammer chart idea of 2 to 5 rings. The primary contribution comes from the closest terrain and this falls in the inner ring
Primary cell size	This cell size is independent of the underlying DTM grid, as a resampling is used. This drives the actual radius for each ring, as the cell size is multiplied by the number of cells in each ring.
Density	This is the assumed terrain or regolith density value. If you use 1 g/cc, you can scale the calculated field later in the spreadsheet
Gravity database	The observed gravity database must include a field for the observation points (X,Y,Z). It is not actually necessary to have the actual observed field, as the aim here is to create a field with the terrain correction fields, without actually applying the corrections at this point in the process.
Digital terrain model grid	This is a standard geophysical grid that has the local DTM, with good extents, far beyond the gravity observation stations. SRTM can be OK, but generally something with better resolution is required.
Output report	A very comprehensive report is created every time this option is run. A full explanation of all the options is recorded in this report.

Control	Description
Treatment of elevation observation data	Interestingly, the accuracy of the survey height of the gravity observation station, often is out of sorts with the DTM grid, so the option exists to locally adapt the DTM to include the local survey heights. However, this may not work, and you may have to settle for the DTM view of the elevation at the station to avoid “pimples”
Local elevation interpolation method	If you want to use the local observation of elevation, and mix this with the DTM, this requires a local interpolation - two methods are available, inverse distance squared and a MINQ.

Complete Bouguer anomaly advanced options

Parent topic:
Process menu

Here is finally where the ring dimensions are finalised. The radius of the inner ring is 16 * cellsize. This inner ring is always carefully modelled with high resolution prisms, and the option for sloping top prisms does make quite a difference.

Advanced Options

Terrain Bottom (RL):

Radius (in cells) of Ring 1:

Radius (in cells) of Ring 2:

Radius (in cells) of Ring 3:

Radius (in cells) of Ring 4:

Radius (in cells) of Ring 5:

Calculate scalar/tensor terrain correction using...

☒ sloping top prisms (accurate)

☐ flat top prisms (fast)

Controls in this dialog box

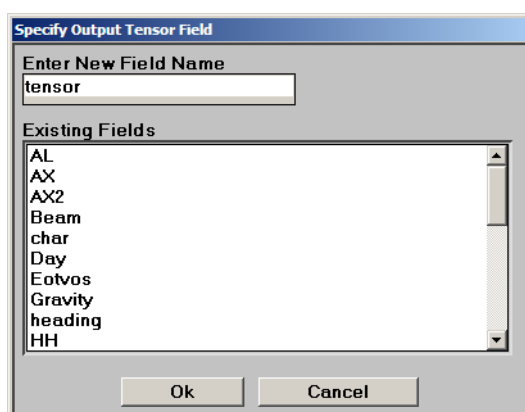
Control	Description
Terrain bottom	For the tensor case, a notional bottom RL is also required. make this well below the terrain elevation.
Radius of rings	The ratio of 16,32,64,256,1024 is the traditional scalar gravity ratios. As gradiometry falls off by one order of magnitude greater than scalar gravity, a different ratio series with a sharper roll off is recommended. eg use a finer cellsize and 9,27,81,243.
Calculate scalar/tensor terrain correction using	It is recommended you start with flat top prisms and just 2 rings to make sure all is looking as it should, eg the DTM grid is appropriate and the order of the terrain correction seems in order. Then repeat the process with a higher number of rings and use the sloping top option.

Create tensor from inline or crossline

Parent topic:
[Process menu](#)

If you have FTG data from the contractor that is close to what was actually measured, you may also have inline and crossline fields, often called I1,I2,I3, C1,C2,C3. You also need a carousel angle, which captures the angular orientation of the rotating GGI's within the Lockheed-Martin instrument. use the advanced alias assignment in the **ProjectManager** tool to set these fields in your database, to the corresponding alias. This must be done before you can successfully recreate the tensor field from its parts. Choose this option, specify the output tensor field name, and the option to form the tensor takes very little time to compute. Note that FTG data from this instrument is universally declared and formed in a left handed coordinate reference frame with East/North/Down.

The tensor training course contains a great trove of practical information about the details of all the gradient instruments in use today.



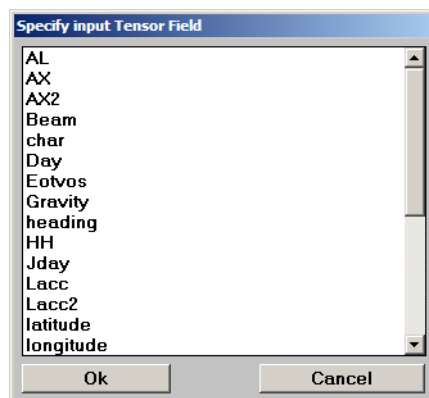
Controls in this dialog box

Controls	Description
Enter new field name	required name for the formed tensor field
Existing fields	Use the alias facility as described above to tie the observed inline and crossline fields , whatever they are named, to their function.

Create inline or crossline from tensor

Parent topic:
Process menu

This is the reveres process to the option above. Given a FTG field, decompose it back to its inline and crossline parts, with the carousel angle held constant to an azimuth of 0 degrees.

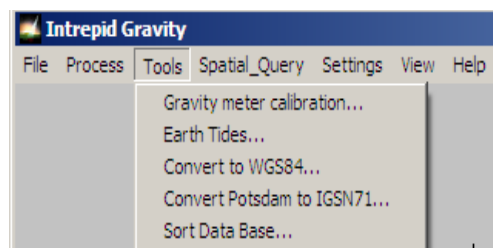
**Controls in this dialog box**

Control	Description
Input tensor field	Choose any tensor field in your database, and recompute equivalent inline and crossline components.

Tools menu

Parent topic:
Gravity corrections (T54)

This collection of functions tend to be to the side of mainstream gravity processing.



In this section:

- [Gravity meter calibration](#)
- [Earth tides](#)
- [Convert to WGS84](#)
- [Convert Potsdam to IGSN71](#)

- [Sort database](#)

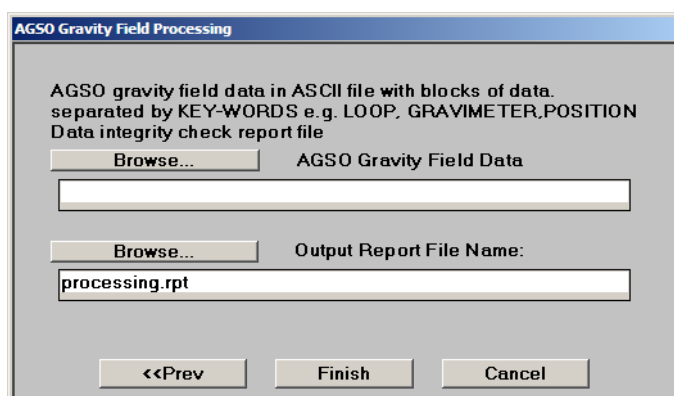
Gravity meter calibration

Parent topic:
[Tools menu](#)

The AGSO field data format is designed to accomodate gravity readings collected from calibration ranges. Using the known calibrated gravity stations, INTREPID can calculate new instrument (scale) factors, and can optionally apply these to all the gravity readings during the data reduction and network adjustment process.

Calibration and scale factor results are written to Section 3 of the processing report. See [Gravimeter calibration \(R29\)](#) for details.

Contact INTREPID if you wish to have access to examples of land gravity meter calibrations.



Controls in this dialog box

Controls	Description
AGSO gravity field data	An ASCII file that contains field observations from a calibration exercise, so there are many repeats, and possibly 2 or more meters, occupying several well known and observed gravity stations.
Output report	standard report file for capturing results

Earth tides

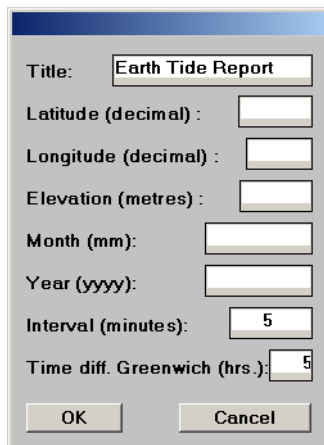
Parent topic:
[Tools menu](#)

Most gravity field data format is designed to accomodate earth tides. The value of gravity at any point on the Earth varies during the course of the day because of the tidal attraction of the sun and the moon. INTREPID automatically applies Earth tide corrections during the data reduction and network adjustment process. INTREPID uses the Longman formula.

Earth Tide corrections may also be calculated manually, and the results written to a report file.

Select **Earth Tides** from the **Tools** menu.

Specify the location and time interval. Specify the name of the report file.



A dialog box titled "Earth Tide Report" with the following controls:

- Title:
- Latitude (decimal):
- Longitude (decimal):
- Elevation (metres):
- Month (mm):
- Year (yyyy):
- Interval (minutes):
- Time diff. Greenwich (hrs.):
- OK button
- Cancel button

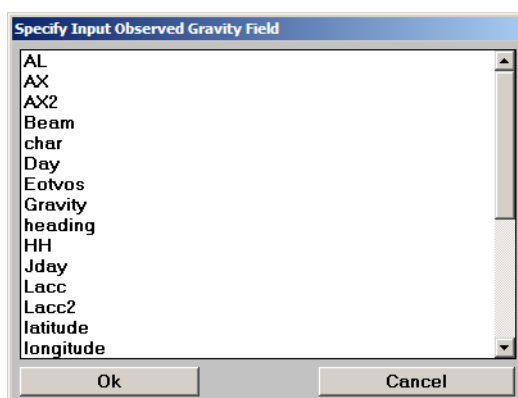
Controls in this dialog box

Controls	Description
Title	A title
Latitude	where on the earth
Longitude	where on the earth
Elevation	where on the earth
Month	what month are you interested in?
Year	what year are you interested in?
Interval	dump values for every interval in minutes
Time difference	offset in time from GMT

Convert to WGS84

Parent topic:
Tools menu

Use this to convert an Observed gravity field from a non-WGS84 gravity datum to the WGS84 gravity datum. Specify the new gravity field name in the Specify Output Observed Gravity Field dialog box.



A dialog box titled "Specify Input Observed Gravity Field" with a list box containing the following items:

- AL
- AX
- AX2
- Beam
- char
- Day
- Eotvos
- Gravity
- heading
- HH
- Jday
- Lacc
- Lacc2
- latitude
- longitude

At the bottom are OK and Cancel buttons.

Controls in this dialog box

Controls	Description
Specify input observed gravity field	You are prompted for an observed gravity field in your database, together with its datum

Convert Potsdam to IGSN71

Parent topic:
[Tools menu](#)

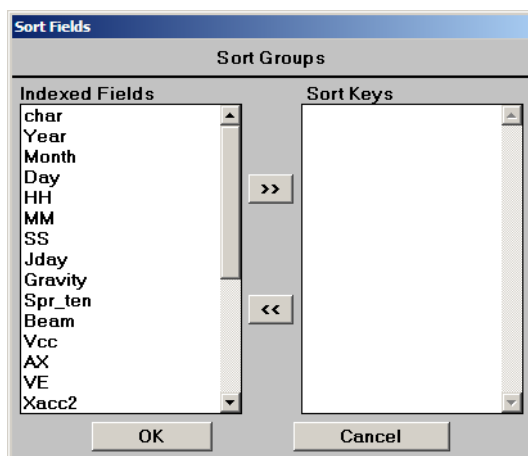
Use this to convert an Observed gravity field from the Potsdam gravity datum to the IGSN71 gravity datum

Sort database

Parent topic:
[Tools menu](#)

Sort the database on any indexed field. Sorting the database on Station number is a useful way of checking for repeat stations. The INTREPID database format is very flexible. The primary focus is its ability to handle groups of fields, associated with a profile. With the classic random point nature of a regional gravity database, the default key fields, such as StationNumber, may contain many duplicate readings, as this field does not have to be a primary key.

In the standard field loop reduction process, the final principal facts process does reduce the readings back to just one entry for each station. This function gives you the ability to reorder the data rows, to force all the readings for each station to be in order, when viewed in a spreadsheet, or dumped, via export, to an ASCII file.



Controls in this dialog box

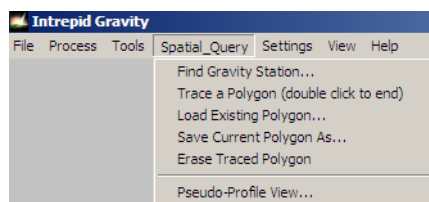
Controls	Description
Sort groups	Function name
Indexed fields	Choose the field(s) that you want to sort the random records in the database by. eg StationNumber
Sort keys	This is the chosen field(s) prior to the sort being actually undertaken.

Spatial query

Parent topic:
Gravity
corrections
(T54)

Gravity data is collected often regionally, in temporal loops and spatial random points. You may suspect that data in one region has some sort of a drift or error, and you wish to find the “outlier”.

This option allows you to drill down to individual stations by name, to lasso groups, and to query in a temporal/spatial sense, the readings, so you can spot trends.



In this section:

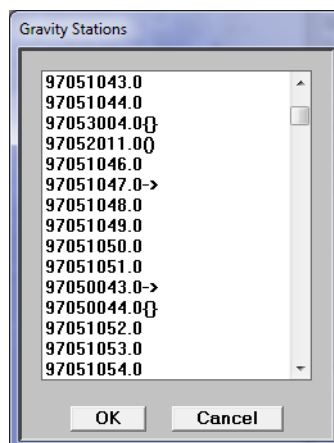
- [Find gravity station](#)
- [Trace a polygon](#)
- [Load existing polygon](#)
- [Save current polygon](#)
- [Erase traced polygon](#)
- [Pseudo profile view](#)

Find gravity station

Parent topic:
Spatial query

Choose this option to get every entry in a “StationName” field to report. Click on an entry in this list, and the background graphics window will show the requested station in a purple highlight. This is a reverse search. Much the same can also be done just simply typing the station name into the top right hand side text window, followed by a carriage return.

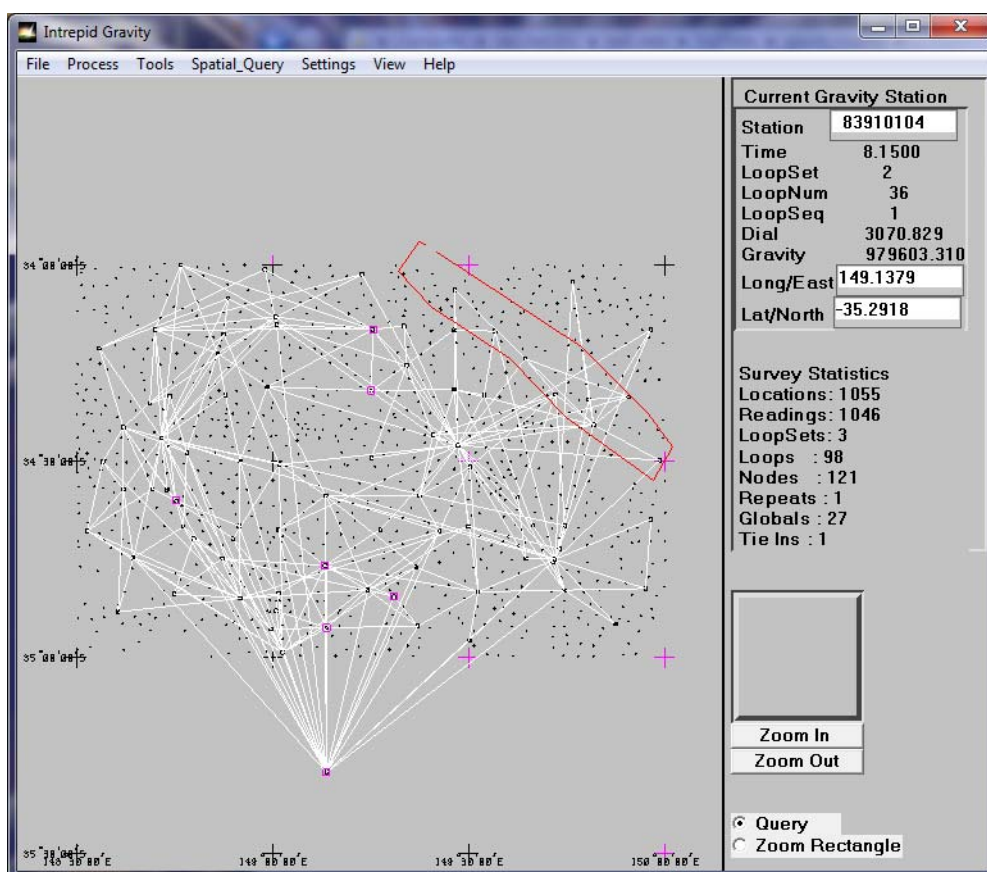
A text convention is also used to indicate which stations are nodes and repeats, when you have a processed field loop observation dataset loaded. The number of connections above one to other stations, is recorded by the “white” lines, and also the ->, {}, (), ::, ## text code following the important stations.



Trace a polygon

Parent topic:
Spatial query

The aim here is to use the Spatial Query>Trace a polygon, to select a subset of the gravity readings in a spatial sense, regardless of when the data was acquired, to define a psuedo section for which a profile of gravity can be viewed.



Load existing polygon

Parent topic:
Spatial query

Instead of doing on-screen digitizing of a polygon, you can choose an a existing polygon dataset. This can come from anywhere, provided it meets the INTREPID format requirements eg Arc shape file, something saved from the subset tool etc.

Save current polygon

Parent topic:
Spatial query

You can save the polygon you have traced, to a polygon dataset, by choosing this option. Provide a polygon dataset name. this is a standard polygon dataset, and can also be saved in any GIS format.

Erase traced polygon

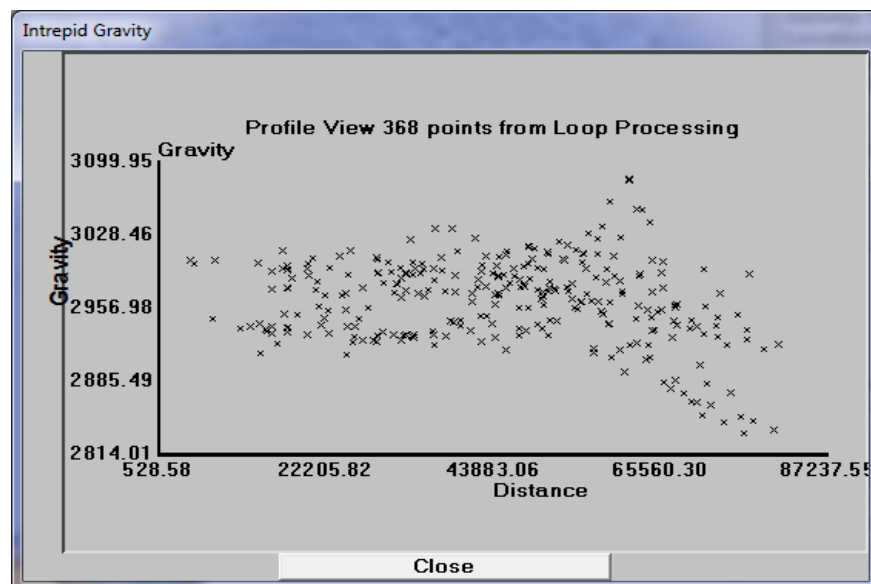
Parent topic:
Spatial query

This option simply erases the transient polygon graphic, and resets back to a neutral state.

Pseudo profile view

Parent topic:
Spatial query

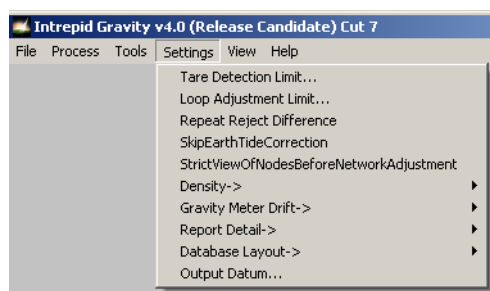
The longest dimension of the psuedo section is used to define an X axis. All the gravity data points that lie within the polygon, are projected onto the section plot, with the gravity reading as the Y axis. You can mouse click on any of the crosses wiuthin this plot, to get a station report in the underlying RHS reporting pane. When you have loop data, you can isolate individual field data records, to get to a seeming outlier etc etc.



Settings menu

Parent topic:
Gravity corrections (T54)

To change a setting, choose a corresponding item from the Settings menu.



In this section:

- [Tare detection limit](#)

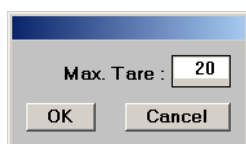
- [Loop adjustment limit](#)
- [Repeat rejection difference](#)
- [Skip Earth tide correction](#)
- [Strict view of nodes](#)
- [Density](#)
- [Gravity meter drift](#)
- [Report detail](#)
- [Database layout](#)
- [Output datum](#)

Tare detection limit

Parent topic:
[Settings menu](#)

A tare is an unacceptable difference between data acquired at successive stations. It may be caused by a meter being knocked or dropped, and causes the subsequent readings to be higher or lower than before.

The Tare Detection limit is the maximum acceptable tare. If a tare exceeds this value, INTREPID insert a warning in the processing report file.



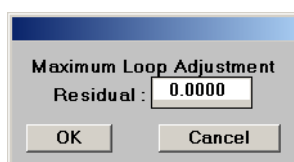
Controls in this dialog box

Controls	Description
Maximum tare	The default is 20 mGal, and this comes from experience in the field. You would like to know if your meter appears to have been bumped from one session to the next.

Loop adjustment limit

Parent topic:
[Settings menu](#)

The Loop Adjustment Limit is the limit of error for network adjustment corrections. The loop adjustment stops when the maximum change for an iteration is less than the specified limit. The default value is 0.01 mGal.



Controls in this dialog box

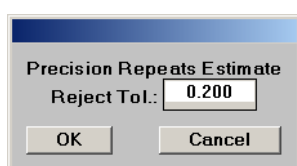
Controls	Description
Maximum loop adjustment	When doing a loop levelling adjustment, an iterative improvement in the mis-fits will continue until the maximum mis-fit is less than this limit. There is usually no cause to change this value.

Repeat rejection difference

Parent topic:
[Settings menu](#)

This option sets the rejection tolerance value for repeat station values.

The default value is 0.20 mGal.

**Controls in this dialog box**

Controls	Description
Precision repeats estimate	Enter a value to specify an acceptable difference between readings at the same station.

Skip Earth tide correction

Parent topic:
[Settings menu](#)

Skip Earth Tide Correction

Turn off the Earth Tide correction. The default is to include it while doing the standard land-based loop processing stream. This option also applies to marine processing for L&R instruments etc. The workflow for this case, is tied up in batch processing options for this tool, and is described in the marine gravity processing cookbook.

Strict view of nodes

Parent topic:
[Settings menu](#)

Strict View of Nodes

A node (or tie) is defined as a station that appears in more than one loop. INTREPID has two views of what constitutes a node:

1 Strict (rigorous) view

Station numbers that are repeated **and** arranged in time order are used as nodes. The first and last stations in a loop are not used as nodes unless they are repeated. Fixed stations are not used as nodes unless they are repeated.

2 Relaxed view

Station numbers that are repeated are used as nodes. All first and last stations in a loop are used as nodes. All fixed stations are used as nodes.

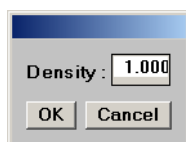
The default setting is the Strict View of Nodes.

Density

Parent topic:
[Settings menu](#)

You can set the assumed density of material/terrain as appropriate. These values are used for simple Bouguer and terrain corrections. Validate your choice in the pop-up that is provided just before a calculation is done.

The default density for land is (2.67 g/cm³).



Controls in this dialog box

Controls	Description
Density	Enter a density value for the Bouguer slab correction. You can specify land, sea, lake, marine sediment and ice values.

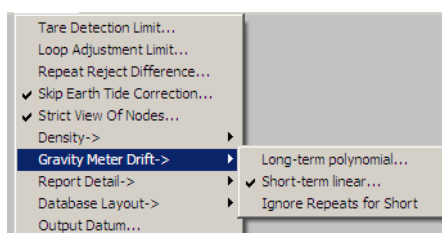
Gravity meter drift

Parent topic:
[Settings menu](#)

INTREPID has a choice of two drift models:

- The conventional short term linear drift uses a piecewise linear method to remove the drift for each loop. The **IgnoreRepeatsForShort** option also allows you to ignore repeat stations for the purpose of drift calculations.
- Long term polynomial drift is calculated using a weighted least squares fit to the nodes, with an outlier rejection criteria. A 2nd order drift rate curve is derived. The area under this curve is found by integration and this is the model of the drift adopted.

Long term polynomial drift is the default setting.



Options in this menu

Options	Description
Long-term polynomial	Use a long term view of the metre drift, as modelled in a piecewise polynomial drift curve, to help level the survey
Short-term linear	A short term linear drift curve is considered adequate for most surveys. As you lean towards doing geodetic quality work, switch to long-term drift modelling.
Ignore repeats	Variability at a station can distort gradients in the drift curve, so turn off.

Report detail

Parent topic:
[Settings menu](#)

You can select brief or verbose processing reports.

The default setting is Brief.

See [Gravity processing reports](#) for details of the brief import and loop reduction report.

The verbose processing report includes:

Section 1a—Check Print of positions.

The station number, latitude, longitude and height for each station.

Section 10—Earth tide corrections.

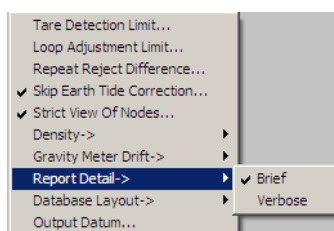
The Loop no, Station no, latitude, longitude, elevation, time, GMT, Earth tide and adjusted gravity for each station.

Section 11.2—Final Drift Control Adjustments

Drift control data for each loop sequence.

Section 12.2—Loop Adjustments

Further detail about the loop adjustments.



Options in this menu

Options	Description
Brief	The default report type is brief, and is usually adequate for all needs
Verbose	If a survey is giving you trouble and will not level very well, try turning on the extra reporting.

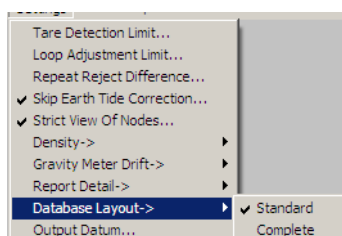
Database layout

Parent topic:
[Settings menu](#)

INTREPID writes a standard set of fields to the gravity datasets. The field names follow the ASEG standard naming convention. All supporting fields are populated directly by the program.

The Complete form of the layout contains additional fields created by the Terrain Correction calculations.

The default setting is Standard. See [INTREPID gravity point datasets \(R28\)](#) for details of fields.

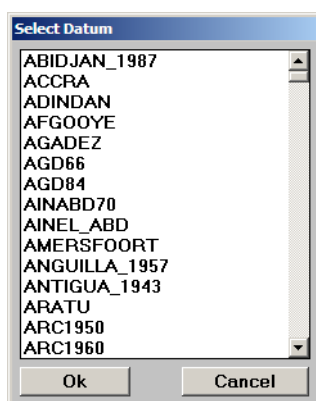
**Options in this menu**

Options	Description
Standard	Geoscience Australia has defined a standard set of fields for the principal facts gravity stations, available using the GADDS web-based data delivery system. This is powered by INTREPID JETSTREAM
Complete	Optional extra gravity fields can also be generated by the processing within this tool, when doing field data reduction.

Output datum

Parent topic:
[Settings menu](#)

The spatial (XY) datum can be changed for output. It does not have to be the same as the input spatial datum. Select the datum you require from the Select Datum dialog box. For instance, all the land based survey loops maybe recorded using a GPS and Latitude/Longitude pairs. At the very end of the processing, you may wish to present the principal facts in a projected map format, with an Easting and a Northing.



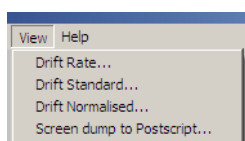
Options in this dialog box

Options	Description
Select datum	Select the Ellipsoid datum you wish to have the data calculated in.

View menu

Parent topic:
Gravity
corrections
(T54)

Options for graphically displaying the drift of the gravimeter.



In this section:

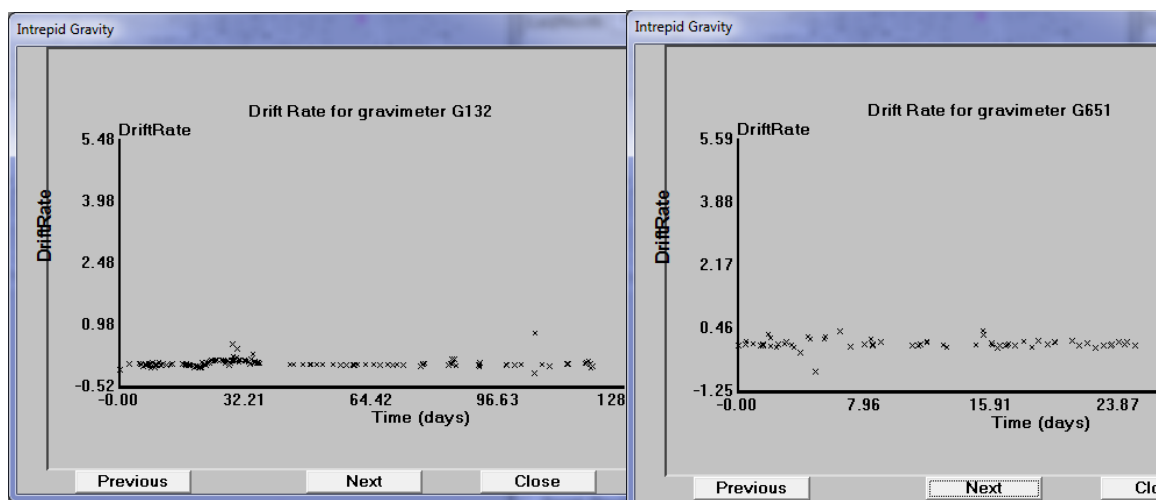
- [Drift rate](#)
- [Drift standard](#)
- [Drift normalised](#)
- [Screen dump to postscript](#)

Drift rate

Parent topic:
[View menu](#)

This graph shows the drift rate for each tie in the first GMLS of the dataset(in this case G132 & G651). This includes ALL ties (nodes); the ties at the beginning and end of each loop (loop ties), and other ties within the GMLS. Use the Next and Previous buttons to view other GMLS in the dataset.

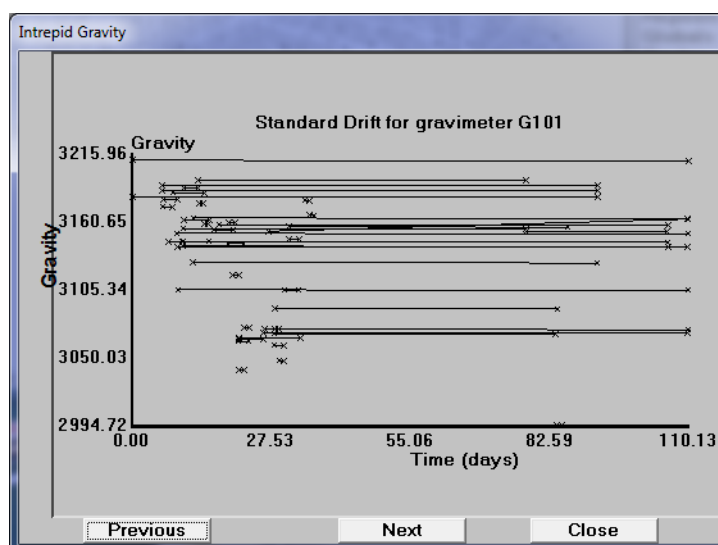
The horizontal axis represents the time (days) since the survey began (shown over 128 days). The vertical axis is the drift divided by the time difference (dial reading/ hr).



Drift standard

Parent topic:
[View menu](#)

This graph shows the drift for each loop in the first GMLS of the dataset. The horizontal axis represents the time (days) since the survey began. The vertical axis is the dial reading. Each line segment represents one loop. The length of the line segment indicates the time taken to complete the loop. The gradient, if any, shows the drift at the same node.

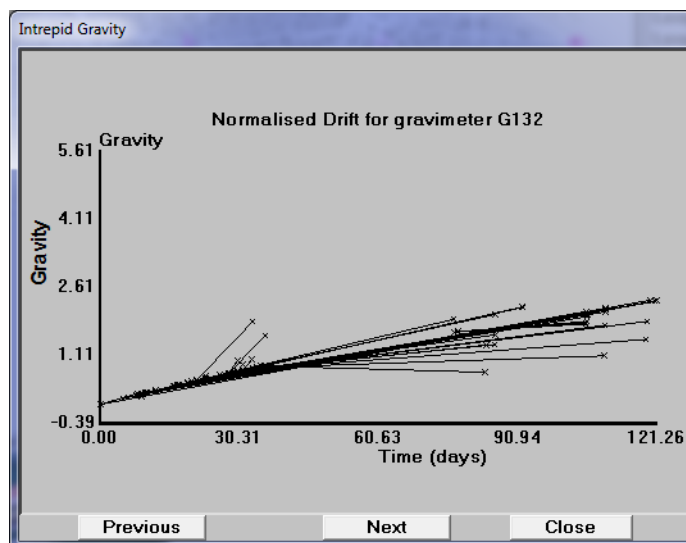


Drift normalised

Parent topic:
[View menu](#)

This graph shows the normalised drift for each loop in the first GMLS of the dataset. The normalised graph shows each segment shifted up or down to fit a curve. This gives some sense of a drift continuum for the GMLS.

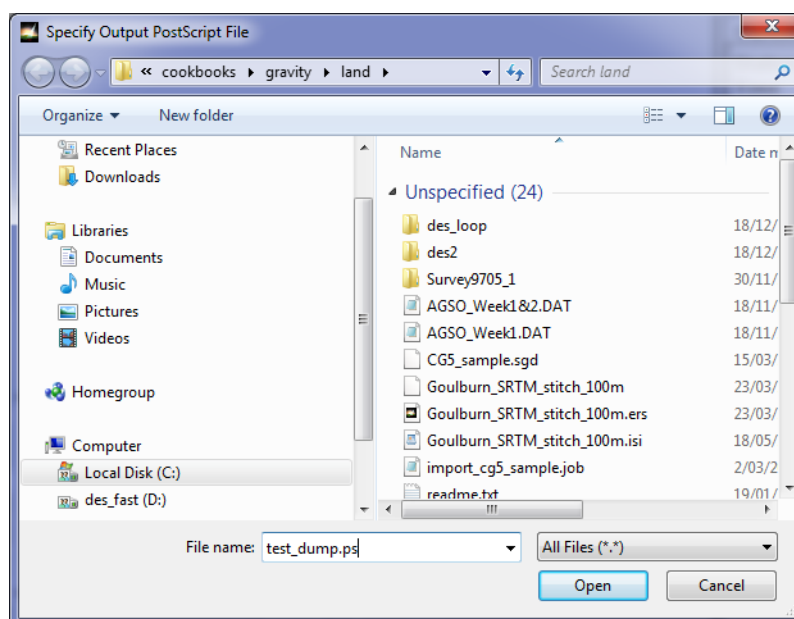
The horizontal axis represents the time (days) since the survey began. The vertical axis is the normalised dial reading. INTREPID fits a polynomial to the gradients (drift) of the line segments (loops). It then shifts all line segments up or down so that they start on this polynomial.



Screen dump to postscript

Parent topic:
View menu

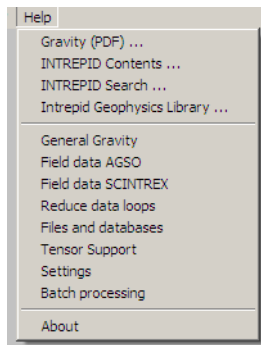
Use the graphics engine within this tool, to create a postscript file with the loops, stations layout.



Help

Parent topic:
Gravity corrections (T54)

You can use the help menu to display help text on the topics shown in the menu illustration below.



Using task specification files

Parent topic:
Gravity corrections (T54)

You can use the help menu to display help text on the topics shown in the menu illustration below.

You can store sets of file specifications and parameter settings for Gravity Corrections in task specification (**.job**) files. At V5.0, we also support the use of GOOGLE protobuf syntax to accomplish the same function. This move to the GOOGLE technology is a longterm strategic one, designed to leverage off this kindness and strength. As we then also publish the formal language syntax, you can inspect the language for extra hints as to what new functions, or undocumented functions are available within this and every other tool. Example of duplicated processes in the old and new syntax, are distributed at v5.0, and we also routinely put these same processes through the automatic batch testing procedures. GOOGLE parsers are pretty good at reporting syntax errors down to line number and column.

>> To create a task specification file with the Gravity Corrections tool

- 1** Specify all files and parameters.
- 2** If possible, execute the task (choose Apply) to ensure that it works.
- 3** Choose Save Options from the File menu. Specify a task specification file (INTREPID adds the extension **.job**) INTREPID creates the file with the settings current at the time of the Save Options operation.

For full instructions on creating and editing task specification files see [INTREPID task specification \(.job\) files \(R06\)](#) files.

>> To use a task specification file in an interactive Gravity Corrections session

Load the task specification (**.job**) file (File menu, Load Options), modify any settings as required, then choose Apply.

>> To use a task specification file for a batch mode Gravity Corrections task

- 1** Type the command **gravity.exe** with the switch **-batch** followed by the name (and path if necessary) of the task specification file.

For example, if you had a task specification file called **surv_034.job** in the current directory you would use the commands

```
gravity.exe -batch surv_034.job
```

Task specification file examples

As part of the standard software distribution, we give you example files. Look in the “jobs/gravity” and for V5.0, tasks/gravity” directories.

Here is an example of an Gravity Corrections task specification file using the new V5.0 protobuf syntax that is distributed. The exact same job is also distributed in the “jobs/gravity” area.

```
# Example task file V5.0 protobuf syntax - gravity
# Usage: fmanager -batch gravity_utilities.task
#
# Shows 3 utility operations for the marine environment
# 1. compute Freeair
# 2. compute Eotvos
# 3. compute Bouguer

IntrepidTask {
  Gravity { # free air
    GravityDatabase: "../datasets/Survey9705_1..DIR";
    ObservedGravity: "../datasets/Survey9705_1..DIR/GRAV";
    FreeAir: "../datasets/Survey9705_1..DIR/freeair_new";
    ReportFile: "freeair.rpt";
    RunType: FREE_AIR;
    OutputUnits: MILLIGALS;
    TerrainType: OCEAN_SURFACE;
    DatumType: IGSN71;
  }
}

IntrepidTask {
  Gravity { # compute Eotvos
    GravityDatabase: "../datasets/Survey9705_1..DIR";
    ObservedGravity: "../datasets/Survey9705_1..DIR/GRAV";
    CraftVelocity: "../datasets/Survey9705_1..DIR/velocity_filtered";
    LineBearing: "../datasets/Survey9705_1..DIR/Azimuth";
    Eotvos: "../datasets/Survey9705_1..DIR/eotvos_new";
    ReportFile: "eotvos.rpt";
    RunType: CALC_EOTVOS;
    OutputUnits: MILLIGALS;
    TerrainType: OCEAN_SURFACE;
    DatumType: IGSN71;
  }
}

#
#
# In this example the density contrast used for the Bouguer correction
# is 1.17 g/cc, equivalent to 2.2 g/cc total after addition of water
# density.
# Eg: land&saltwater = 1.17 (2.2-1.03)
#
IntrepidTask {
  Gravity { # compute Bouguer
    GravityDatabase: "../datasets/Survey9705_1..DIR";
    ObservedGravity: "../datasets/Survey9705_1..DIR/GRAV";
    SimpleBouguer: "../datasets/Survey9705_1..DIR/Bouguer_new";
    StationElevation: "../datasets/Survey9705_1..DIR/Elevation";
    ReportFile: "bouguer.rpt";
    RunType: SIMPLE_BOUGUER;
    OutputUnits: MILLIGALS;
    TerrainType: OCEAN_SURFACE; # flag to control density contrast selection
    DatumType: IGSN71;
    Properties {
      Density_Fresh_Water: 1.0;
      Density_Salt_Water: 1.027;
      Density_Ice: 0.917;
      Density_Land: 2.67;
      Density_LandMinusFreshWater: 1.67;
      # this following is the one being used in this case
      Density_MarineSedimentMinusSaltWater: 1.17; # the one for marine
      Density_Marine_Sediment: 2.2;
      Density_LandMinusIce: 1.753;
    }
  }
}

}
```

A second example shows a terrain correction for a land based context.

```
# Example task file V5.0 protobuf syntax - gravity
# Usage: fmanager -batch gravity_terrain_correction.task
#
# Compute terrain correction (complete Bouguer) for land gravity data.
# Then add the terrain correction to the Bouguer field to create
# the terrain corrected (Complete Bouguer) field.
#
# The process does not actually use the Observed Gravity field.
# Earth curvature correction is irrelevant if radius is < 167 km.
```

```

#
# The gravity datum choice does not affect the terrain correction output.
# The terrain correction will be +ve for the land case, and +/- ve for the
# airborne and submarine cases.
#
# The terrain density should match the Bouguer density being added to.
#
# Use the spreadsheet editor to add the terrain correction to the
# Bouguer field to create the terrain corrected (Complete Bouguer) field

IntrepidTask {
  Gravity { # terrain correction
    GravityDatabase: "../datasets/Survey9705_1..DIR";
    ObservedGravity: "../datasets/Survey9705_1..DIR/GRAV"; # used as a flag field only
    DigitalTerrain: "../datasets/Goulburn_SRTM_stitch_100m.ers"; # DTM grid for this survey
    TerrainCorrection: "../datasets/Survey9705_1..DIR/terrain_correction"; # output for the
correction
    StationElevation: "../datasets/Survey9705_1..DIR/Elevation";
    ReportFile: "terrain.rpt";
    RunType: TERRAIN;
    OutputUnits: MILLIGALS;
    TerrainType: LAND_SURFACE;
    DatumType: POTSDAM;
    Terrain {
      Cell_Size: 100.0
      Max_Circles: 5
      Earth_Curvature_Correction: true;
      UseDTM_Elevations_At_Observation: true;
      Add_Obs_Elevations_To_DTM: true;
      LocalInverseDistanceInterpolator: true;
      UseSlopingTopPrisms: true;
      Number_CPUs: 2; # this tests multi-threading
    }
    Properties {
      Density_Land: 2.67; # density to use in terrain calcs
    }
  }
}
}

```

Gravity processing reports

Parent topic:
[Gravity corrections \(T54\)](#)

This section contains annotated processing report samples for import, loop reduction and terrain correction. The Gravity tool also generates reports for individual corrections. See the description of the individual corrections earlier in this manual for individual correction sample report listings.

The INTREPID Gravity tool generally appends reports to the current processing report file. In some cases it enables you to specify the file name for the processing report and continues to append reports to this file throughout the session. If you do not specify a report file name, it uses **processing.rpt** (except for terrain correction—its default report name is **terrain.rpt**)

Report files are always in the INTREPID current directory (current directory when you launched the Gravity tool).

In this section:

- [Gravity data import](#)
 - [Report header - Summary of the dataset characteristics](#)
 - [1. Position data](#)
 - [2. Control gravity data](#)
 - [3. Gravimeter calibration loop data](#)
 - [4. Gravimeter loop datasets](#)
 - [5. Node list](#)
 - [6. Global ties \(nodes\)](#)

- [7. Internal loop repeat stations](#)
- [8. Data structure check](#)
- [Reduce loop data to final](#)
 - [Report header](#)
 - [9: Meter corrections](#)
 - [10: Earth tide](#)
 - [11: Gravity drift corrections, model statistics and estimate of precision](#)
 - [—Corrections](#)
 - [—Precision statistics](#)
 - [—Node values](#)
 - [12: Node connections analysis & levelling](#)
 - [13: Global adjustments](#)
 - [14: Applying meter scale factor to all loop data](#)
 - [15: Calculating adjustments to global nodes](#)
 - [16: Final values](#)
- [Terrain correction report](#)

Gravity data import

Parent topic:
[Gravity processing reports](#)

Report header - Summary of the dataset characteristics

Gravity Field Data Checking Report.....

Starting from AGSO field and checking loops, GPS etc.

Intrepid Gravity v3.4 cut 61 - 20/ 3/2000 22:14:16

Survey 9705: Goulburn Regional Infill - New South Wales

1. Position data

Summary of the dataset characteristics

1.1: Position Set 1

Coordinate Reference Frame	- UNKNOWN
Ellipsoid	- ANS
Horizontal Datum	- AGD66
Vertical Datum	- AHD
Coordinate Projection	- GEODETIC
Position Accuracy	- 0.000001
Elevation Accuracy	- 0.020
Data Bounds	
Number of Stations	- 1054
Longitude (Max, Min)	- 150.000188 (97050366.000), 148.499622 (97050129.000)
Latitude (Max, Min)	- -33.997255 (97052132.000), -34.998606 (97051037.000)
Elevation (Max, Min)	- 1266.371 (98010003.000), 282.508000 (97050083.000)

2. Control gravity data

List of loop network control stations

2: Control Gravity Data**2.1: Station List**

Station	Obs Gravity	Precision	Datum	Theoretical	Comments
83910104	979603.3100	0.1000	IGSN71	979757.8421	Old AGSO Building Main Door

2.2: Primary Control Gravity Station - 83910104**3: Gravity Meter Calibration Loop Data**

No Gravity Meter Calibration Data

3. Gravimeter calibration loop data

Calibration data is optional

See [Gravimeter calibration \(R29\)](#) for details about this section.**4. Gravimeter loop datasets**

For each GMLS, this section lists:

- Gravimeter details
- Operator details
- A summary for each loop

4.2: Gravity Meter Loop Set 2

Gravimeter - LCR_G(LCR): Meter - G132, Adjustment to Manufacturers

Scale Factor 1.000000

Gravimeter Reader - HReith

Number of Loops - 11

Loop	Number	Readings	BaseIn	BaseOut	Start		End	
1	16.181	13	83910104	83910104	14/	1/1998	7:15	14/ 1/1998 17:26
2	17.182	15	83910104	83910104	15/	1/1998	7: 9	15/ 1/1998 15:50
3	23.281	20	97051277	97051277	21/	1/1998	8:26	21/ 1/1998 19: 7
4	24.282	16	97051277	97051277	22/	1/1998	7:47	22/ 1/1998 20:11
5	25.283	13	97051277	97051277	23/	1/1998	7:37	23/ 1/1998 16:22
6	31.381	12	83910104	83910104	29/	1/1998	8:16	29/ 1/1998 18:11
7	44.581	16	83910104	83910104	12/	2/1998	8: 9	12/ 2/1998 18:22
8	48.581	13	83910104	83910104	16/	2/1998	8:16	16/ 2/1998 16:41
9	57.781	9	83910104	83910104	25/	2/1998	7:57	25/ 2/1998 18:23
10	58.782	9	83910104	83910104	26/	2/1998	6:57	26/ 2/1998 17:48
11	59.783	9	83910104	83910104	27/	2/1998	7: 8	27/ 2/1998 19:56

5. Node list

A tie (node) is a station with readings in more than one loop. Ties are important cross-reference points for corrections.

Nodes are also important cross-reference points for corrections.

X	node in loop
D	node in loop used for drift control
F	fixed node in loop

5.4: Gravity Meter Loop Set 4

Number of Nodes from CreateNodeListFromLoops = 6

Initial nodes 6

Loop	1	2	3	4	5	6	7	8
Node								
97050001	D	D				X		
98012078		X					X	
97051277			D	D	D			

98010010				X	X			
83910104						D	D	D
97053023							X	X

6. Global ties (nodes)

Ties (nodes) common to more than one gravimeter

6.1: Global node list

Gravimeter	G132	G132	G101	G101	G651
Nodes					
83910104	X	X	X	X	
97050001	X		X	X	X
97053000	X				X
97053001	X		X		X
97051036	X		X		X
97051068	X	X			
97051069	X	X	X		X
97051083	X				X
97051126	X				X
97051134	X		X		X
97052137	X		X		X
97051233	X	X	X		X
97051277	X	X	X	X	X
97052037	X				X
97052021		X			X
97052038		X			X
97052011		X			X
97053023		X		X	
97053017			X		X
97051135			X		X
97052198			X		X

6.2: Number of global nodes 21**7. Internal loop repeat stations**

These are stations with multiple readings in one loop only. These points are useful cross-reference points for corrections.

7.2: Gravity Meter Loop Set 2

Loop	Station	No. Repeats
1		
2		
3		
4		
	97052117	1
5		
6		
	97053008	1
7		
8		
9		

10

11

Total Number of Repeats 2**8. Data structure check**

This section reports

- Start and finish station
- Ties (nodes) in the loop
- Possible tares in the data.

8.1: Data Structure Check for Gravity Meter Loop Set 1

Loop	FirstAndLast	TimeOrder	Tares	Position	Nodes
1	ok	ok			

**** possible tare(s) in data**

Station1	Station2	Difference
83910104	97050001	28.134
97050001	83910104	-28.197

	ok	ok	ok
2	ok	ok	

Reduce loop data to final

Parent topic:
[Gravity processing reports](#)

Report header

```
*****
Intrepid Gravity v3.5 cut 62 (static)
Start processing - 20/ 4/2000 13: 0:24
*****
```

Gravity Processing Report

Starting from Loop Data Base and doing All adjustmentsINTREPID repeats and reports sections 1–8 as shown in [Gravity data import](#)**9: Meter corrections**

INTREPID lists each GMLS that it corrects using the gravimeter calibration file.

MeterCorrections for set number 1**MeterCorrections for set number 2****MeterCorrections for set number 3****MeterCorrections for set number 4****MeterCorrections for set number 5****10: Earth tide**

INTREPID lists each GMLS that it corrects using an internally stored Earth tide model.

EarthTide correction for set number 1**EarthTide correction for set number 2**

EarthTide correction for set number 3

EarthTide correction for set number 4

EarthTide correction for set number 5

11: Gravity drift corrections, model statistics and estimate of precision

—Corrections

INTREPID finds the difference between the readings at the start or finish station at the beginning and end of the loop. It then interpolates a correction for each observation in the loop to correct this discrepancy, assumed to be instrument drift.

11.1 Gravity Meter Drift Correction for set number 2

Least Squares Polynomial Fitting - multi-loop

Rejecting Too small an Interval (Time Segment) for Base Stations
Skipping time segment as too small (less than 0.480 of hour)

Base = 83910104, Obs.Drift = 0.121752, Time interval = 0.233333 (hrs)

Initial Goodness of fit for drift curve polynomial of order 2 is = 0.021089 (ChiSqr)

Probability that observed ChiSqr for a correct model be less than this is = 0.000000

Rejecting Outlier Intervals(Time Segments) for Base

Note, the gradient drift polynomial uses X = MidTime, Y = Obs.Drift

The Calc. Drift is the Least Squares Estimated drift

Base	StartTime (hrs)	interval Calc (hrs)	MidTime (hrs from start)	Obs.Drift (per hr)	Calc.Drift (per hr)	status
83910104	0.0000	10.1833	5.0917	-0.00209	0.00072	
83910104	10.1833	13.7167	17.0417	0.00082	0.00071	
83910104	23.9000	8.7000	28.2500	0.00101	0.00070	
83910104	32.6000	328.4167	196.8083	0.00042	0.00057	
83910104	361.0167	9.9167	365.9750	-0.00211	0.00044	
83910104	370.9333	325.9833	533.9250	-0.00066	0.00031	
83910104	696.9167	9.4000	701.6167	-0.00866	0.00018	ignored
83910104	706.3167	0.5667	706.6000	0.03182	0.00017	ignored
83910104	707.1167	85.9167	750.0750	-0.00013	0.00014	

Final Goodness of fit for drift curve polynomial order 2 = 0.002152 (ChiSqr)

Probability that obs ChiSqr for a correct model be less than this = 0.000000

Final polynomial coeff for time =0.017289, time**2 = -0.000447

A long term drift correction found by integrating final polynomial drift curve

Integrated Correction Polynomial coeff for time = 0.000000,time**2
= 0.017289,time**3 = -0.000223

Correction Polynomial base value (est long term drift correction) = 0.003658

—Precision statistics

INTREPID estimates and reports the precision statistics for the data after the drift correction process. It calculates this from the variations in readings for nodes and other stations with more than one observation.

11.3 Estimating Loop Precision for set number 2 after drift

Number of repeat stations candidates for Precision Estimate = 2

Number of repeat station differences actually used for current loop set = 2

Precision estimate statistics for repeats for this loop

Maximum	-0.009414
Mean	-0.009781
Mean Absolute Deviation	0.000368
Variance	0.000000
Standard Deviation	0.000520
Skew	0.353553
Kurtosis	-2.750000

—Node values

INTREPID reports the drift results for each tie (node), showing original and corrected values.

11.4 Print node values for set number 2 after drift corrections

Node =	83910104	
Loop	Original Reading	Drifted Val
16.181	3130.391	3307.377
16.181	3130.262	3307.349
17.182	3130.374	3307.350
17.182	3130.199	3307.353
31.381	3130.513	3307.304
31.381	3130.448	3307.278
44.581	3130.279	3306.963
44.581	3130.147	3306.880

12: Node connections analysis & levelling

(Loop adjustment and misclosure statistics)

Adjustments between loops within a GMLS:

INTREPID makes an interpolated correction to all readings based on discrepancies between readings at stations with more than one observation within each loop

12.0a CreateNodeListFromLoops for set number 2

Number of Nodes from CreateNodeListFromLoops = 10

12.1 NodeConnectionLevelling for set number 2

Loop connection search commenced (not by time)

```

16.18
** only node found 83910104.0000 is reading 12
17.18
** only node found 83910104.0000 is reading 14
23.28
24.28
*** Internal loop - tied to node 97051277.0000 from reading 0 to reading 15
25.28
31.38
** only node found 83910104.0000 is reading 11
44.58

```

```
*** Internal loop - tied to node 83910104.0000 from reading 13 to reading 14
*** Internal loop - tied to node 83910104.0000 from reading 14 to reading 15
```

```
.
.
.
```

12.2 LoopAdjust for set number 2

```
Loop adjustment search - control parameters
Stop if Max Loop Change less than : 0.010
Stop after Max Loop Iterations : 20
```

```
Iteration      1 forward
Average misclosure change  0.117216
New average              3251.291855
Running Sum of all changes 0.000000
Absolute Sum of all changes 0.000000
Max improvement at       97053023 of 0.413483
Iteration      2 backwards
Average misclosure change  0.133276
New average              3251.367516
Running Sum of all changes 0.000000
Absolute Sum of all changes 0.000000
Max improvement at       97052021 of 0.223050
Iteration      3 forward
Average misclosure change  0.072963
New average              3251.361520
Running Sum of all changes 0.000000
Absolute Sum of all changes 0.000000
Max improvement at       97053023 of 0.177428
.
..
Iteration      20 backwards
Average misclosure change  0.017381
New average              3251.472899
Running Sum of all changes 0.000000
Absolute Sum of all changes 0.000000
Max improvement at       97051277 of 0.028694
Total Iterations      20
Original average 3251.267805
Final Iter. Average change 0.017381
```

Loop Adjusted values for nodes

SUM OF DIFFERENCES OLD = 0.000000 NEW = 0.000000

Loop Adjusted values for Stations

Station	Old Value	New Value
Loop 16.18		
83910104	3307.377	3307.367
98012062	3299.757	3299.747
98012065	3263.726	3263.716
98012066	3256.575	3256.565

```

.
.
.
Loop      59.78
 83910104   3307.046   3307.367
 97051069   3251.141   3251.442
 98011120   3267.075   3267.379
 97051126   3243.990   3244.298
 98012151   3245.606   3245.926
 98012150   3249.269   3249.590
 98012152   3252.691   3253.013
 98010207   3179.853   3180.183
 83910104   3307.022   3307.367

```

12.4 Estimating Loop Precision for set number 2 after loop adjustment

Number of repeat stations candidates for Precision Estimate = 2

Number of repeat station differences actually used for current loop set = 2

Precision estimate statistics for repeats for this loop

Maximum	-0.001131
Mean	-0.017294
Mean Absolute Deviation	0.016163
Variance	0.000522
Standard Deviation	0.022858
Skew	0.353553
Kurtosis	-2.750000

13: Global adjustments

Adjustments between loops within a GMLS:

INTREPID compares the global tie values for all pairs of GMLS. If the corrections have been performed properly, there should be a constant difference between the gravimeters (or, perhaps, a difference with an observable linear trend when the ties are arranged chronologically).

Each GMLS has so far been treated independently.

Examine the global nodes and work out best fit adjustment for the whole.

Populate secondary fixed nodes for GMLS = 1

Global Node	Value
83910104	3307.3203
97050001	3277.5042
97053000	3283.0206
97053001	3275.2682
97051036	3280.9495
97051068	3240.9753
97051069	3251.4699
97051083	3242.7234
97051126	3244.2991
97051134	3136.2051
97052137	3162.3516

97051233	3186.5019
97051277	3253.1758
97052037	3227.5754

14: Applying meter scale factor to all loop data

You can specify a scale factor for each gravimeter (usually 1). INTREPID applies this scale factor to each set of loop data

See [Gravimeter calibration \(R29\)](#) for details about scale factors and calibration

15: Calculating adjustments to global nodes

Adjustments to tie each GMLS to the network control station:

INTREPID compares the global tie (node) values to the network control station. The global tie has a known gravity. INTREPID adjusts all ties accordingly.

15: Calculating adjustments to global nodes

Doing tie in to control value at fixed stations

Primary Fixed Node adjustment to GMLS 1

Fixed Node	Adjustment
83910104	976295.990

Mean	976295.989737
------	---------------

Adjusted secondary fixed nodes for GMLS = 1 by 976295.9897

Global Node	Value
83910104	979603.3100
97050001	979573.4940
97053000	979579.0104
97053001	979571.2579
97051036	979576.9392
97051068	979536.9650
97051069	979547.4596
97051083	979538.7131
97051126	979540.2889
97051134	979432.1948
97052137	979458.3413
97051233	979482.4916
97051277	979549.1655
97052037	979523.5652

...

Secondary Fixed Node adjustment to GMLS 5 of 976439.6164

using an average adjustment via secondary nodes, count = 31

Adjusted secondary fixed nodes for GMLS = 5 by 976439.6164

Global Node	Value
97050001	979573.5846
97053000	979579.0865
97052011	979566.9397
97053001	979571.3244
97052021	979547.3547
97051036	979576.9323
97052037	979523.8117
97052038	979540.0260
97051069	979547.2874
97051083	979538.5529

```

97051126      979540.1987
97051134      979432.1641
97053017      979455.7550
97051135      979457.2111
97052137      979458.3478
97052198      979452.5674
97051233      979482.6323
97051277      979549.4942

```

16: Final values

A reduced set of data that is the 'best estimate' of the gravity for each station. This data is stored in the field **bsgrav**.

16: Final Values

Simple Bouguer Anomaly

land Density : 2.670

Datum : IGSN71

Station	Latitude	Longitude	Observed	StdDev	No.	Height	Vert_Offset	Free Air	Bouguer
83910104	-35.29333	149.13667	979603.310	0.0000	44	565.000	0.00	19.8502	-43.3733
97050001	-34.98807	149.02449	979573.562	0.0371	23	613.030	0.00	30.8983	-37.6997
97053000	-34.92465	149.13736	979579.053	0.0446	7	551.991	0.00	22.9309	-38.8369
97051001	-34.91920	149.16973	979579.231		1	556.609	0.00	24.9970	-37.2875
97051002	-34.93906	149.19984	979582.288		1	559.904	0.00	27.3852	-35.2680
97051003	-34.97221	149.21932	979581.461		1	576.656	0.00	28.9161	-35.6117
97051004	-34.99164	149.26253	979584.411		1	579.199	0.00	31.0013	-33.8111
97051005	-34.99776	149.22310	979581.655		1	586.229	0.00	29.8959	-35.7031
97051006	-34.98000	149.18748	979567.439		1	638.322	0.00	33.2680	-38.1602
97051007	-34.99683	149.15984	979563.917		1	654.965	0.00	33.4545	-39.8361
.									
.									
.									

Average	Observed	Free Air	Bouguer
	979516.864	35.341	-40.100

Gravity output DB created Survey9705, in GEODETIC proj, AGD66 datum
 *** 1046 stations output in newly created intrepid dataset
 data stored in -> Survey9705

Terrain correction report

Parent topic: Here is a sample terrain correction report.

Gravity processing reports

```

*****
Intrepid Gravity v4.2 for Windows by TECHBASE1 (Free Version)
Start processing - 17/10/2008 20:47:47
*****

```

Gravity Complete Bouguer Report..... Intrepid Gravity v4.2 for Windows by
 TECHBASE1 (Free Version) - 17/10/2008 20:47:47

Terrain Corrections

A. Conventions

This method calculates a terrain correction (TC) either for the vertical component of gravity or the full gravity gradient tensor. It does not modify the observed gravity field.

After the TC is calculated, you must add the corrections to your (Bouguer corrected) values.

For traditional scalar vertical component of Gravity -

The gravity effect is calculated using the vertical edge prism model for density ring 0 or, optionally and more exactly, a sloping top triangle model and the thin rod model for density rings 1-4.

The prism model is assumed to lie directly below the gravity observation to a depth equal to the absolute value of the difference in height between the gravity station and the average height of the terrain at the prism.

The triangular prism has the advantage of a sloping top.

As the near field terrain effects/errors are greatest, this proves to be a major improvement.

reference

Woodward, O. J. (1975) The Gravitational Attraction of Vertical Triangular Prism

geophysical prospecting 23, pp. 526-532.

Obviously each prism/triangle/rod model is offset in (X,Y) from the gravity station.

For Full Vector and Full Tensor Gradiometry of Gravity -

Gravity component and Gradient Tensor calculations are performed using a facet technique for forming sloping top triangular prisms for the inner ring. The outer rings are four sided flat-top prisms. The Gravity and magnetic potential, components and tensor gradients for the mass above/missing to the side of your observation point is computed. We only report the gravity components and tensor Tensor units are always Eotvos, regardless of what you want for the vertical component.

The algorithm is by Holstein and is written up in Geophysics.

The size of the model is dependent on the distance from the gravity observation.

There are five possible observation density rings, specified by the user as radii. The number of models increases by a factor of two in each ring so that at maximum observation density(0) there will be 256 models for every model at the lowest density(eg 4).

The sign convention for elevation is heights above sea-level are positive and bathymetry depths should always be negative. This is your responsibility!! The elevation used to calculate the correction for any cell is the average elevation of the cell. This is calculated by gridding the centre of all the unit cells that comprise the cell. This involves alot of gridding but ensures a very accurate result.

The firstrad and lastrad variables define which of radii will be calculated. The minimum radii is 0 and the maximum is 4

The radii pairs describe the observation density eg (10,50)(50,250)(250,1000)(1000,5000)(5000,20000)

As gravity effect decreases as the square of distance, a scheme where the cell sizes reduce every doubling of distance is recommended as the minimum. eg

Minimum cell size = 5

Define first ring = 5 -> 80m

Second ring 80 -> 160

Third ring 160 -> 320

Fourth ring 320 -> 640

Fifth ring 640 -> 1280

For mountainous regions use the following scheme

(5) 5-160 , 160-640, 640-1280, 1280-5120, 5120-20480

For flatter regions use the following scheme

(5) 5-80, 80-320, 320-640, 640-1280, 1280-20480

Height +ve above sea-level

Consistent units for distance and heights should be used - eg meters

B. Land vs Marine vs Airbourne

All calculated terrain corrections for Land are positive.

The Earth Curvature correction is negative for Land and can introduce small negative corrections increasing with the Height of your station above the Geoid. On the other hand The Earth Curvature correction is mostly positive for Marine. Both Submarine and Airborne terrain corrections can be both positive and negative.

If you require a submarine correction, sea-level is assumed as the observation height.

If you require an airborne correction, gps height/altitude is required as the observation height. This is a vital ingredient for this situation!!

This run is for a terrestrial correction only

IMPORTANT NOTE

The tool only calculates a terrain correction at an observation point where the Observed Gravity field at that point is non-Null.

You can use this as a way of limiting where you want calculation to be done for your survey

C. Data Input reporting

Geoid GA07

Cell 1000.00 is the minimum sub cell size.

Cell 16000.00 is the maximum sub cell size.

Your input Density is 2.670 g/cc.

Output units are Milligals

Terrain correction calculated using sloping top triangles

Calculating standard VERTICAL GRAVITY terrain correction

Calculating !!!LAND!!! based Terrain Correction

Gravity DB opened D:/Intrepid/cookbook/gravity/datasets/Longford

Co-ordinates are in TMAMG55 proj, AGD66 datum

X X , Y Y Hts. D:/Intrepid/cookbook/gravity/datasets/Longford/Elevation

Digital Terrain Model grid opened D:/Intrepid/cookbook/gravity/datasets/
Longford_Terrain
in TMAMG55 proj, AGD66 datum
DTM grid nulls 127536

Radii for gravity terrain correction estimates around each observation

Ring 1	- start	0.0	, end	1600.0
Ring 2	- start	1600.0	, end	3200.0
Ring 3	- start	3200.0	, end	6400.0
Ring 4	- start	6400.0	, end	25600.0
Ring 5	- start	25600.0	, end	102400.0

Report on Local Improvement Estimation scheme for Digital Elevation data...
Allocating swap space for gravity observation requirements 6421 points or 4
MBytes

Reading observed data file...

The number of observed records inc. nulls. 21

Number read into the program 21

Number of Null records 0

Determining gravity data limits ...

X Range 473069.674332 to 477129.768455

Y Range 5386120.542243 to 5390784.200477

Z Range 316.380000 to 1227.000000

Using Inverse distance gridding for DTM elevation interpolation...

Adding observed elevations to dtm list...

Moving station elevations onto DTM grid...

Calculating terrain response...Calculating for each row and column of DTM grid

Reporting observed gravity data density for each grid cell

The density is found by finding the distance of all observations to the
closest edge of the cell.

This distance is compared to the radii and an appropriate density is found.

If a observation is found within a cell the density is set to the maximum.

The algorithm stops when a minimum density is found or all points have been
searched

0 = most dense, 5 means no observations

Problem domain is rows 32, cols 32

Scanning box row 1, central easting	450425.0	central northing	5364325.0
-------------------------------------	----------	------------------	-----------

Scanning box row 2, central easting	450425.0	central northing	5365925.0
-------------------------------------	----------	------------------	-----------

...

Scanning box row 31, central easting	450425.0	central northing	5412325.0
--------------------------------------	----------	------------------	-----------

Scanning box row 32, central easting	450425.0	central northing	5413925.0
--------------------------------------	----------	------------------	-----------

Terrain Complete , 16896 prisms & 34999 rods calculated.

X Range 473069.674332 to 477129.768455
 Y Range 5386120.542243 to 5390784.200477
 Z Range 377.794309 to 1192.490601
 TC Range 1.062443 to 13.692027

End processing - 13/11/2008 16:23: 6, Log = terrain.rpt

Frequently asked questions

Parent topic:
[Gravity corrections \(T54\)](#)

Q : *Can the station name be numbers AND letters or only numbers? ie; 90001000, 90001000R?*

Case 1 - AGSO style:

There are two key words that can be used for specifying the Station numbers in a GPS section

- **POSITION**

98931602, 119:48:05.28, -23:24:59.48, 552.0

or

- **LINE_POSITION**

100, 98931602, 119:48:05.28, -23:24:59.48, 552.0

There is no provision for alphanumeric characters in the station numbers for either of the above.

Case 2 - Scintrex style:

CG3 stations can have N S E or W in the station name and often do. The station naming convention for a CG3 is often grid or line based and is quite at odds with the original AGSO inspired YYYYNMMN style convention. We have generalized the rules to cope with common styles of station numbering.

Q : *For horizontal datum I get only AGD66. How can I change that to, say, WGS84?*

Case 1 - AGSO style:

The line with the keyword **POSITION** defines what you want for both horizontal and vertical datums. Just change it to suit your conditions.

For example:

POSITION, UNKNOWN, CLARKE, ED50, PULKOVA, NUTM23, 0.00001...

Note that you **must** use names that are known to POSC.

Case 2 - Scintrex style:

Changes can be made using the importGPS (GPS Field Data) menu and also the same keyword in the batch/job file. WGS84 is the default for the CG5 case.

Q : *In general I guess the position must be always in Geographic coordinates and cannot be projected coordinates?*

No, you can give each position data set in any coherent independent projection/datum

you like... and even mix and match if you want. We have samples of datasets being imported with GEODETIC and UTM etc that we can supply. You also have the option of changing from the input Datum to another Datum on output.

Q : Control Gravity Reference: Control gravity value, Accuracy of gravity values, What exactly are these?

A : This is an estimate of the precision of the fundamental tie-in station and is often of an accuracy that is 3 or 5 times better than the standard loop collected with a CG3, for example, for an absolute FG5 meter, you should get an accuracy $< .2 \mu\text{ms}^{-2}$.

Q : Gravimeter Loop set: Nominal scale factor: What is this?

A : Before you have conducted your own calibrations of your meter, (and there is provision for you to do this for both L&R and Scintrex meters), you are obliged to believe the manufacturer, or other authority as to what the current scale factor is. We default our Nominal Scale factor to 1.0. After calibration, you may have a slightly better adjustment available so a number like .9995 may emerge.

A : The gravity tool has an option for you to conduct your own calibration surveys and it calculates this number for you for each meter/reader combination. We can supply a sample calibration survey upon request.

Q : Q: Why is the dynamic range of the reported terrain correction TC range not the same as the dynamic range of the compl_boug field?

A : If you turn off the Earth curvature correction they will be the same.

Q : Can I compute a Bouguer correction for my FTG data, and does it make sense to do so?

A : The concept of a simple Bouguer slab correction for FTG is suspect, even though you need to do a terrain correction to the Free Air. In this later context, a complete Bouguer FTG tensor has been terrain corrected, assuming a constant density.